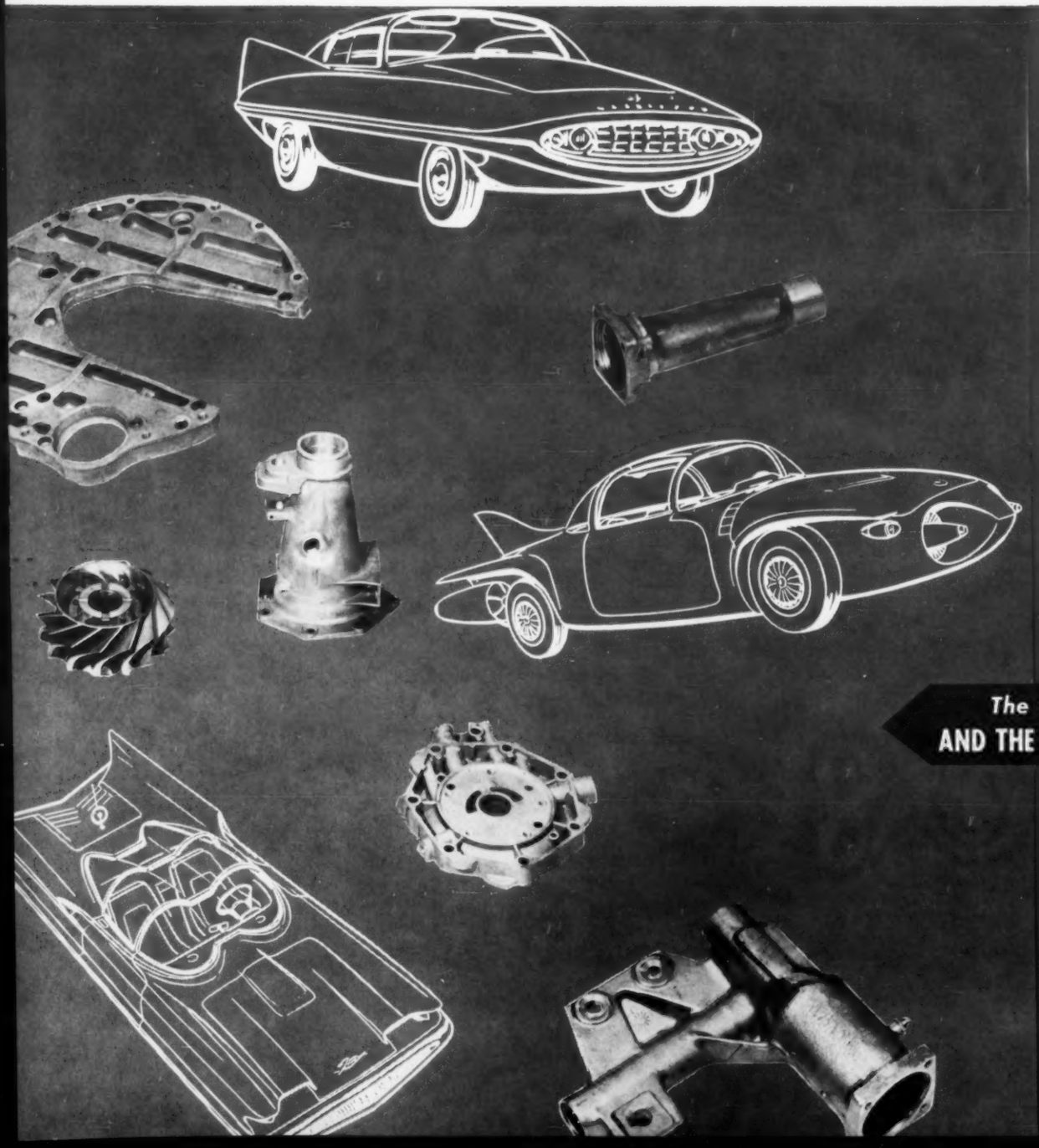
FEBRUARY, 1957

modern castings



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Catalog 9-A describes these furnaces. For a copy write Lectromelt Furnace Company, 316 32nd Street, Pittsburgh 30, Pa. *(a McGraw Electric Company Division).*

CIRCLE NO. 81, PAGE 7-8

future meetings and exhibits

FEBRUARY

4-8 . . American Society for Testing Materials, *Benjamin Franklin Hotel, Philadelphia, Committee Week and Spring Meeting.*

7-8 . . Malleable Founders' Society, *Wade Park Manor, Cleveland. Second Technical and Operating Conference.*

14-15 . . Twentieth Annual Regional Conference, *Hotel Schroeder, Milwaukee. Sponsored by the Wisconsin Chapter and the University of Wisconsin Student Chapter of AFS.*

21-22 . . 25th Annual Southeastern Regional Foundry Conference, *Dinkler-Tutwiler Hotel, Birmingham, Ala. Sponsored by the Birmingham and Tennessee Chapters and the University of Alabama Student Chapter of AFS.*

MARCH

11-15 . . Nuclear Congress, *Convention Hall, Philadelphia.*

13-14 . . Foundry Educational Foundation, *Hotel Cleveland, Cleveland. Annual College-Industry Conference.*

15-16 . . California Regional Foundry Conference, *Claremont Hotel, Berkeley, Calif. Sponsored by the Northern California and Southern California Chapters of AFS.*

18-19 . . Steel Founders' Society of America, *Drake Hotel, Chicago. Annual Meeting.*

23-28 . . American Society of Tool Engineers, *Shamrock Hilton Hotel, Houston, Tex. Silver Anniversary Technical Meeting and Convention.*

25-29 . . American Society for Metals, *Pan-Pacific Auditorium, Los Angeles. Tenth Western Metal Exposition and Congress, to run concurrently with Titanium Conference.*

APRIL

9-11 . . American Welding Society, *Convention Hall, Philadelphia, Welding Show.*

10-11 . . Malleable Founders' Society, *Edgewater Beach Hotel, Chicago. Market Development Conference.*

12-13 . . East Coast Regional Foundry Conference, *Benjamin Franklin Hotel,*

Philadelphia. Sponsored by the Philadelphia, Metropolitan and Chesapeake Chapters of AFS.

29-May 3 . . 7th National Materials Handling Conference, *Convention Hall, Philadelphia.*

MAY

6-10 . . American Foundrymen's Society, *The 1st Engineered Castings Show Music Hall, and The 61st Castings Congress, Netherlands-Plaza Hotel, Cincinnati.*

14-16 . . Armour Research Foundation of Illinois Institute of Technology and Nucleonics Magazine, *Chicago. Industrial Nuclear Technology Conference.*

JUNE

13-14 . . AFS Chapter Officers Conference. *Sherman Hotel, Chicago.*

13-14 . . Malleable Founders' Society, *The Broadmoor, Colorado Springs, Colo. Annual Meeting.*

16-21 . . American Society for Testing Materials, *Chalfonte-Haddon Hall, Atlantic City, N. J. Annual Meeting.*

20-22 . . 2nd Annual AFS Foundry Instructors' Seminar, *Kellogg Center, Michigan State University, East Lansing, Mich.*

20-22 . . Penn State Regional Foundry Conference, *Penn State University, University Park, Pa. Sponsored by the Rochester, Pittsburgh, Metropolitan, Eastern New York, Western New York, Northwestern Pennsylvania, Central New York, Chesapeake and Philadelphia Chapters, and the Penn State University Student Chapter of the American Foundrymen's Society and the Reading Foundrymen's Assn. and Conestoga Foundrymen's Assn.*

23-25 . . Alloy Casting Institute. *The Homestead, Hot Springs, Va. Annual Meeting.*

AUGUST

19-24 . . Swedish Foundrymen's Association, and Sveriges Mekanforbund, *24th International Foundry Congress, Parliament Bldg., Stockholm, Sweden.*

SEPTEMBER

27-28 . . Missouri Valley Regional Conference, *sponsored by St. Louis, Tri-State, and Mo-Kan Chapters of AFS and Missouri School of Mines Student Chapter. Missouri School of Mines and Metallurgy, Rolla, Mo.*

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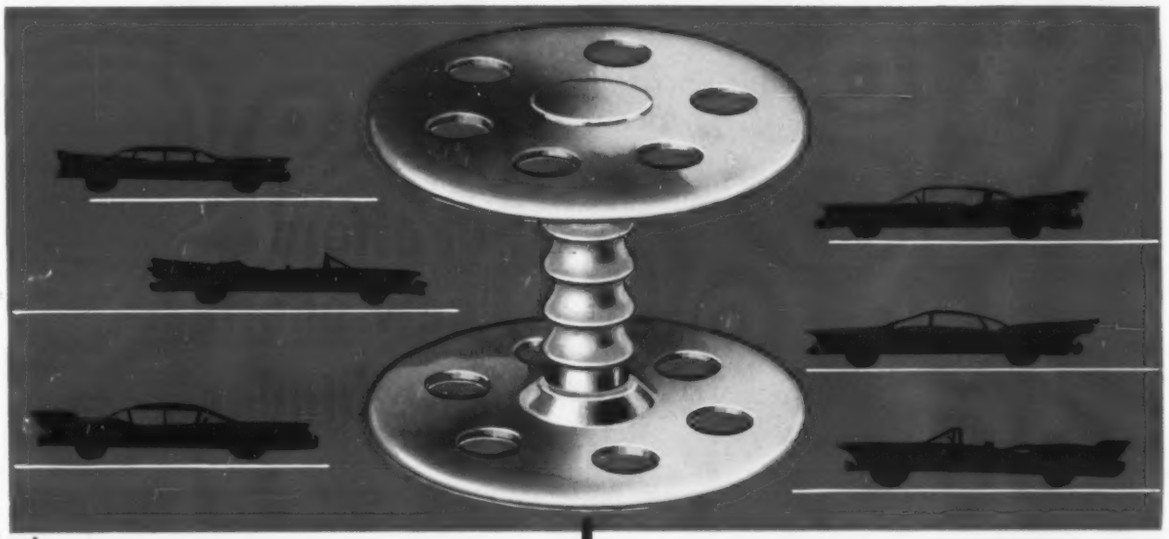

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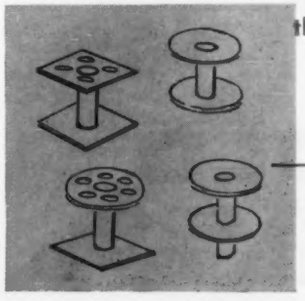

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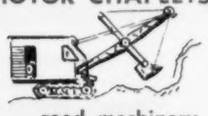

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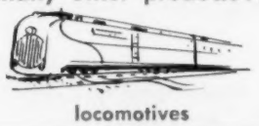

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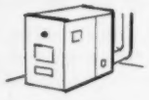

furnaces

stoves

farm machinery

CIRCLE NO. 82, PAGE 7-8

"Foundrez 7605 gives you 4 big advantages"

Low operating cost — Cores made with RCI's Foundrez 7605 resin binder are baked *fast and economically* in this dielectric oven. The cost per ton of labor, materials and fuel is low . . . production rate high.

RCI offers new odorless core binder

FOUNDREZ 7605 is a completely water-soluble amine-aldehyde thermosetting resin. You'll find it's an excellent binder for sands used in making cores for casting copper, brass, bronze, aluminum, magnesium, gray iron and cast iron. Its big advantages are:

1. ODOR ELIMINATION — Foundrez 7605 has been specially developed to eliminate the objectionable formaldehyde odor of conventional synthetic core binder resins, while retaining all the advantages of these products.

2. IMPROVED SOLUBILITY — Increased water solubility of Foundrez 7605, compared to conventional synthetic core binders, assures better dispersion of the resin throughout the core mix.

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Reichhold can deliver this new liquid resin to you in tank cars, tank trucks (or, at higher price, in non-returnable 55-gal. drums).

Write to RCI for *Technical Bulletin F-8* which gives typical mixes and performance data for Foundrez 7605 core binder.

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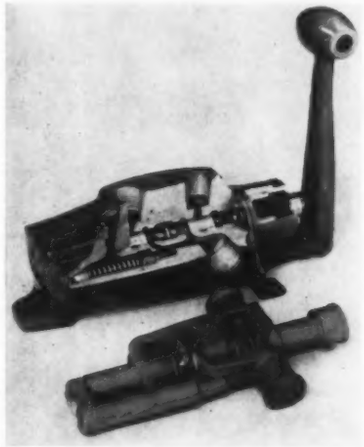
CIRCLE NO. 109, PAGE 7-8

Zinc Die Casting Solves Difficult Coring Problem

Coring of blind holes, undercuts and other difficult operations has been solved by a casting technique which limits machining operations to tapping and boring. This process was developed by Char-Lynn Co., Minneapolis, in the coring of an intricate die cast valve body.

Coring is accomplished by first die casting a zinc die core. This is then



Valve shows detail, severe undercuts cast with zinc core shown in foreground.

coated with an insulating material and positioned in the valve body die. Aluminum is injected in the concentional manner. As the aluminum solidifies, the zinc core picks up heat and becomes molten, causing a build up in pressure. When the pressure reaches a predetermined point, a die valve is opened which relieves the pressure and allows the molten zinc to be discharged from the die. When the aluminum casting has solidified it is removed from the die and the cycle is repeated.

Using this technique, smooth intricate passageways or ports may be cast. Normally, the coring and drilling results in square corners which cause turbulence.

Carbon Dioxide Abstracts

Authoritative information on the CO_2 process is contained in the July issue of the British Steel Castings Research Association. Two papers were presented at the American Foundrymen's Society, 1956 annual meeting, one deals with the process of South Africa and the remainder are from British sources.

february, 1957
vol. 31, no. 2

modern castings

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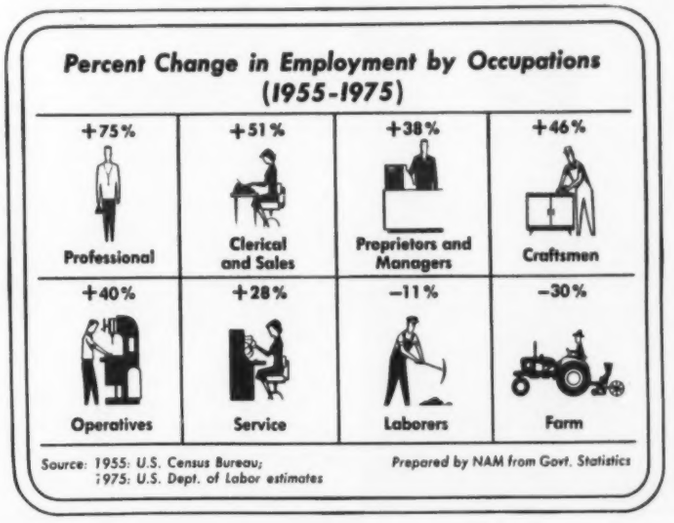
On The Management Side

■ **Nineteen minutes** a day are for profit. The average manufacturing company does not start to make a profit until the last 19 minutes of a normal eight-hour working day. Three hours and 55 minutes will be needed to pay for materials and supplies. If the work day started at 8 am it will now be 11:55 and time for the lunch hour. Two hours and 19 minutes later the plant operation will have paid the wages and salaries and it is 3:14 pm. Federal, state and local taxes must be paid out of the next 43 minutes. Repair and replacement of facilities reqquire 29 minutes and 15 minutes more takes care of research and promotion. It is now 19 minutes till quitting time at 5 pm and in this short time the company must earn the profits required to stay in business. Actually only about half of these minutes provide dividends for the owners. The rest are used for reinvestment in the business. These profit minutes are put at the end of the day because all the company's expenses must be paid before profit—or loss—can be determined. This doesn't leave the owners much margin for error.



■ Castings buyers rank quality far ahead of price or delivery. This opinion was strongly indicated in a recent survey of purchasing agents and design engineers by Richard Meloy, Marketing Director of the Gray Iron Founders' Society. Buyers voiced a desire for assistance from foundries in designing patterns to lower casting costs. Replies from over 1500 design engineers indicated a need for a broad educational program covering the technological advances of the gray iron foundry industry. The engineers expressed a need for information on design of castings and physical and mechanical properties of gray iron castings. Mr. Meloy forecasts that the gray iron foundry industry will top 15 million tons of production in 1957.

■ **Work Smarter Not Harder.**

Young foundry people get the pitch at a recent open house held by Banner Iron Works, St. Louis. Charles Daman, above, explained a display showing the steps in the process of making a casting to a group of wives and children of Banner employees. Later on, some of the visitors tried their own hands at some of the foundry jobs. The young fellow at the left has turned his hand to the operation of a remote control sand slinger. Each of the 200 visitors to the open house was presented with a copy of the AFS publication, "The Foundry is a Good Place to Work." The Banner management believes that the title of the book is a true statement, and thinks that its guests will share that opinion after their visit to the Banner plant.

modern castings album

Older foundry people have recently been in the spotlight, too. In the picture above, Walter L. Seelbach, president of Superior Foundry, Inc., Cleveland, accepts a plaque in appreciation for his ten years of leadership with the company. Seelbach, right, is pictured with Lloyd Leesebert, left, and A. D. Barczak. In the lower picture, Henry J. Hesby, first employee hired by the founders of Campbell, Wyant and Cannon Foundry Co., Muskegon, Mich., is honored at his retirement. Coremaker Hesby saw the company grow to 2700 employees during his 48 years of service. His retirement began with the presentation of a gift and a letter of commendation from R. L. Lindland, CWC president.

Trustees of the new AFS Training and Research Institute have held their first meeting in Chicago. Present for the session were: left to right, A. B. Sinnett, AFS assistant secretary; L. H. Durdin, trustee; Frank W. Shipley, trustee; W. H. Alexander, AFS attorney; Hyman Bornstein, trustee; Wm. W. Maloney, AFS general manager; H. W. Dietert, trustee; S. C. Massari, AFS technical director; and I. R. Wagner, trustee.

ASTM Issues Supplements

Supplements to the 1955 American Society for Testing Materials Book of Standards are now available. The book is published every three years with supplements issued in the intervening years.

The 1956 supplements, issued in seven parts, give 420 specifications, tests and definitions either issued for the first time or revised since 1955.

These supplements consist of ferrous metals; non-ferrous metals; cement, concrete, ceramics, thermal insulation, road materials, water-proofing and soils; paint, naval stores, woods, sandwich construction, building constructions, fire tests, wax polishes; fuels, petroleum, aromatic hydrocarbons, engine antifreezes; rubber, plastics, electrical insulating materials; and textiles, soap, water, paper, adhesives, shipping containers, atmospheric analysis.

The ferrous section consists of 440 pages with 48 standards. Included are steel pipe; steel tubes; steel forged or rolled pipe, fittings and welding fittings; steel castings; steel bolting materials; boiler steel plates and rivets; structural and rivet steel; steel rails and accessories; rolled railroad wheels and tires; spring steel and steel springs; steel chain; corrosion resisting and heat resisting steels; cast iron; and nodular iron.

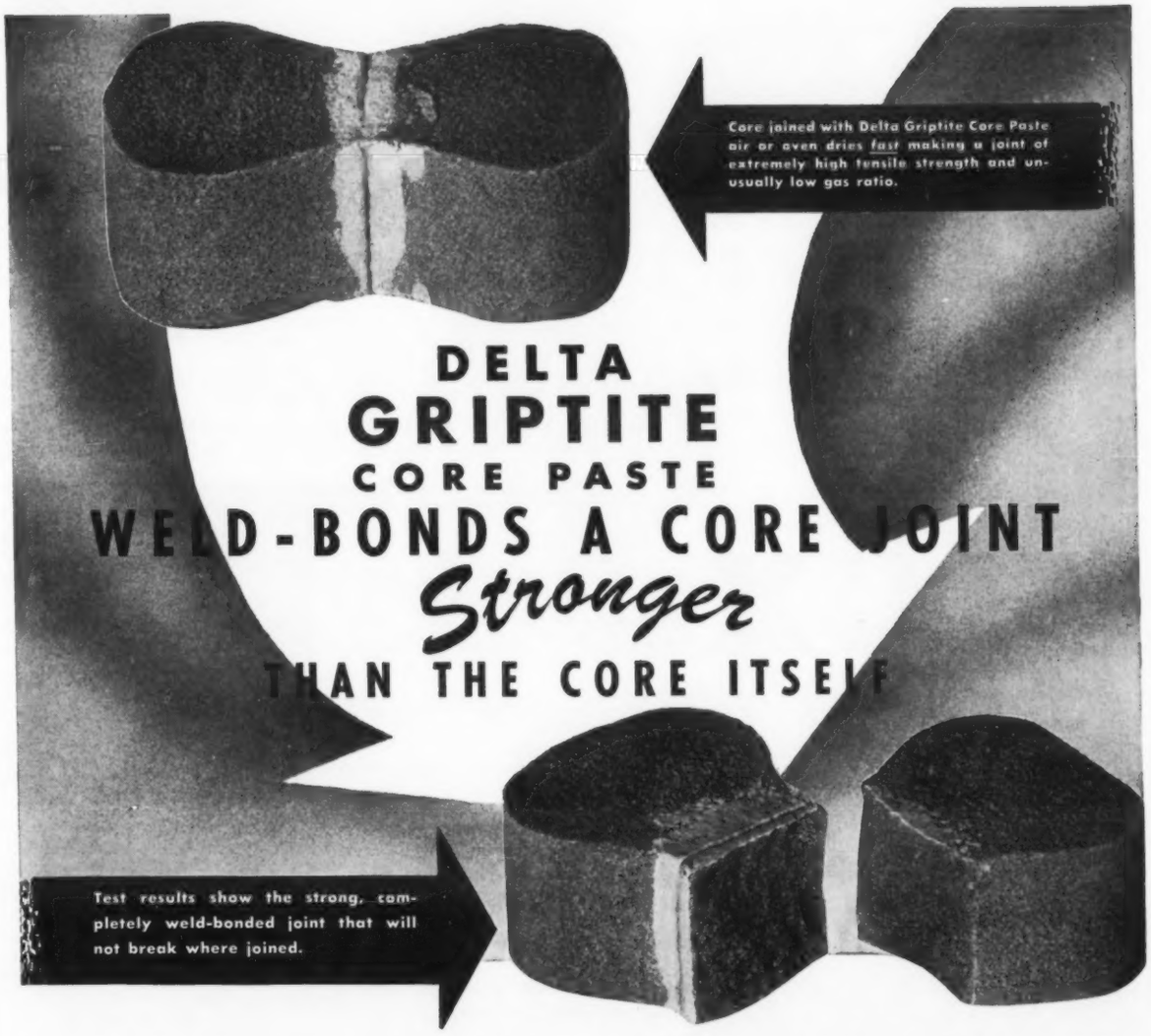
Massillon's Paint Program Improves Work Conditions

"A paint and clean-up program in your foundry will benefit your operation as much as any other expenditure you could make". So advised I. M. Emery, president, Massillon Steel Casting Company, in an address at the annual meeting of the National Safety Council at Chicago.

In a campaign designed to improve environment, Massillon Steel started out by painting the walls of major departments with seafoam green and dark green to wainscoating height, giving what is known as the "eye ease green" effect.

Following the American Standard Association color code for safety painting, the air lines and valves were painted green while the gas were made red. Protecting bars on annealing furnaces were also painted red to warn against bumping or tampering with the equipment. Stationary protrusions were painted yellow.

An ideal time for painting, according to Emery, is during vacation shutdowns. There are always some employees not qualified for vacations with pay who welcome the opportunity to be able to work at this time on the painting program.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CIRCLE NO. 84, PAGE 7-8

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CIRCLE NO. 85, PAGE 7-8

products and processes

Extra! Heat treating furnace uses induction heating principle for small part carbonitriding, bright hardening and

carburizing. Induction heating in "Induct-O-Ring" eliminates heating elements, element terminals, burners, gas or electric connections in furnace proper. Circular shape eliminates usual heat and atmosphere losses when furnace doors are opened. *Lindberg Engineering Co.*

CIRCLE NO. 1, PAGE 7-8

Extra! Annealing, desanding and descalling oven used by auto manufacturer features molten caustic bath which dissolves embedded foundry

sands and provides a stress relieving and soft annealing cycle. Formerly these were separate operations. Available in batch type and continuous models. *Sunbeam Corporation, Industrial Furnace Division.*

CIRCLE NO. 2, PAGE 7-8

Sand ramming device produces 2 x 2 in. specimens to any green hardness. May be adjusted to any height to produce effective cam rise to 2

in. Varying rise changes height from which rammer weight is dropped to produce green hardness to give same green hardness used in foundries. *Harry W. Dietert Co.*

CIRCLE NO. 3, PAGE 7-8

Extra! Malleable iron annealing furnaces designed for mass production are semi-continuous annealing type. Over head design saves space. Cast-

ings are carried on trays mounted on five pairs of rails, both inside and beneath furnace. At end of cycle, trays beneath furnace go into furnace in groups of five. At same time trays of annealed work are discharged and placed on rails beneath furnace. Dur-

ing annealing cycle these trays are transferred to an out rail, unloaded, loaded, and returned to rails beneath furnace, ready for next cycle. *Holcroft & Co.*

CIRCLE NO. 4, PAGE 7-8

Soldering iron uses ultrasonic vibrations for removing metallic oxides, eliminates flux. Used for altering patterns and filling blowholes in aluminum and light alloy castings. Joins dissimilar metals such as brass or

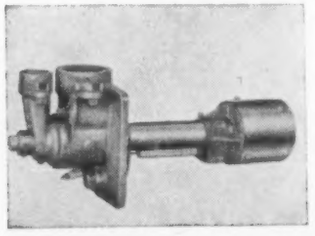
steel to aluminum and zinc base alloys when not subjected to humid conditions. *Acoustica Associates, Inc.*

CIRCLE NO. 5, PAGE 7-8

Grinding wheels, fiber-glass reinforced resinoid, come in two styles. Cut-off wheel up to 20 in. and depressed center type for difficult locations. Used for notching risers, weld cleaning, light snagging. *Electro Refractories & Abrasives Corp.*

CIRCLE NO. 164, PAGE 7-8

Extra! Gas burners, radiant or immersion tube firing models have 5 or 10 to 1 turn down ratio. Major portion of combustion air is introduced around



outside of flame retention nozzle for quieter operation. Air for combustion is supplied through sealed-in burner, eliminates need for eductor or exhaust fan. *Hauck Mfg. Co.*

CIRCLE NO. 6, PAGE 7-8

Automatic tongs handle a variety of shapes and sizes. Comes in 3000, 5000 lb models. Tongs lock as object is lifted, open when burden rests on firm surface. *Heppenstall Co.*

CIRCLE NO. 7, PAGE 7-8

Glass-cloth tape, flame-resistant, used for high temperature marking and

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Golf & Wolf Roads
Des Plaines, Illinois

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Please use card before August 1, 1957

reinforcing and holding operations requiring permanency. *Permacel Tape Corp.*

CIRCLE NO. 8, PAGE 7-8

Core truck, pneumatic-tired equipped with elliptical springs for resiliency

on rough floors. Has 1200 lb capacity. *Chicago Mfg. & Dist. Co.*

CIRCLE NO. 9, PAGE 7-8

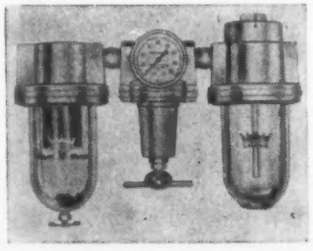
Core binder, air-setting, for heavy cores, is said to have rapid room-temperature curing even at bottom of deep core boxes. Eliminates a major part of waiting period as green bond begins to develope on core surface, a hardness reaction developes through entire depth. *Archer-Daniels-Midland Co.*

CIRCLE NO. 10, PAGE 7-8

Load cell scale has two elements, cells with load suspension unit and an electronically actuated servo-type indicating mechanism. Load bearing elements may be located remotely. Tare weights and units obtained by control knobs. *Toledo Scale Co.*

CIRCLE NO. 11, PAGE 7-8

Filter-regulator-lubricator combinations for compressed air lines come



in seven sizes, from ¼ to 1 in. Regulators in 1¼-1½ in. sizes. *Hannifin Corp.*

CIRCLE NO. 12, PAGE 7-8

Extra! Batch-type, short-cycle circulating draw ovens handle 8000 lb charges of steel castings. A roller-rail hearth and roller-rail charge table complete with tray carrier receives loaded trays for automatic charging into furnace

by hydraulic cylinders interlocked with the door hoists. Circulating fans and alloy ducts in furnace direct circulating gas to all parts of load from combustion chambers below which

have graduated heat-release parts and dual gas-oil burners. Heat-storage chamber below hearth provides extra heat for rapid cycle. *Continental Industrial Engineers, Inc.*

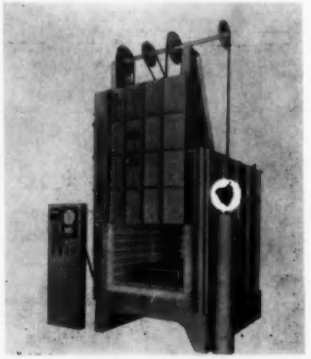
CIRCLE NO. 13, PAGE 7-8

Airless abrasive blast cleaning machine has 14 cu ft capacity. Operated automatically or manually. Abrasive-hurling wheel throws 830 lb abrasives

per minute. Two separators available; one recommended for foundries. Convertible to automation. *Wheelabrator Corp.*

CIRCLE NO. 14, PAGE 7-8

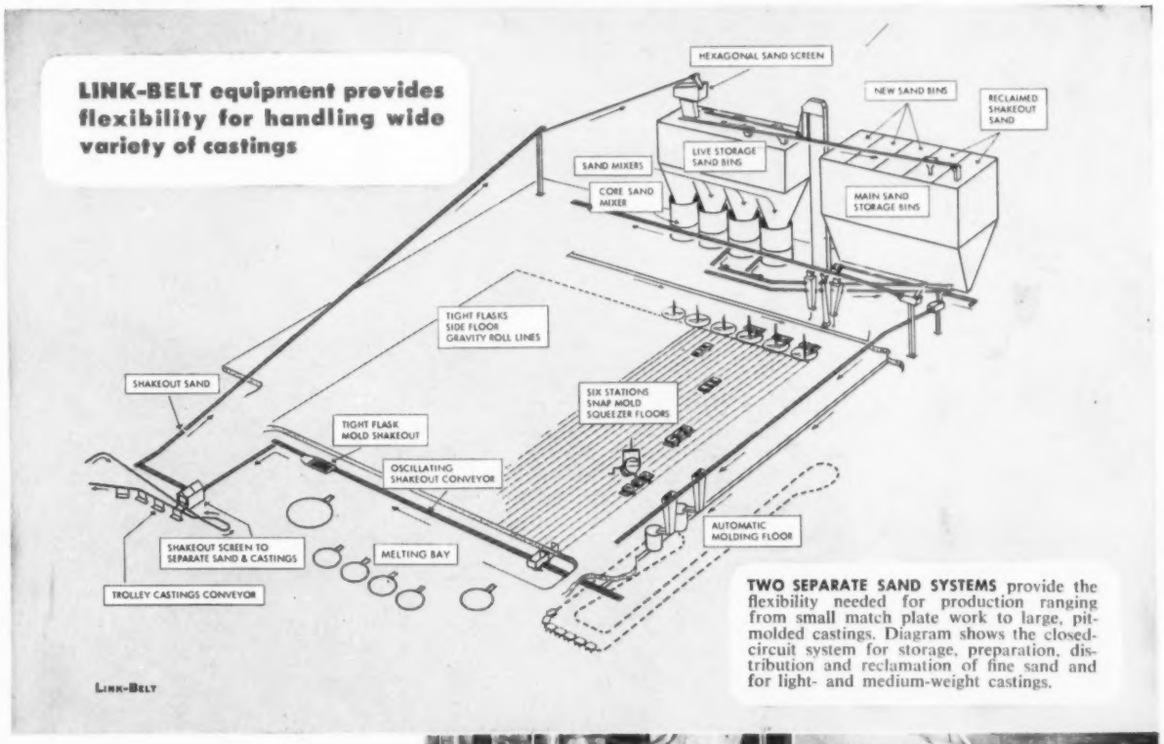
Extra! Annealing oven has 300 to 2200 F temperature range. Heats 2000 lb of steel castings to 2000 F in 4 hours.



Firing chamber temperature gradients are controlled by input controllers, zone located thermocouples, a recorder controller and thermocouple switch.

General Metals jobbing foundry approaches

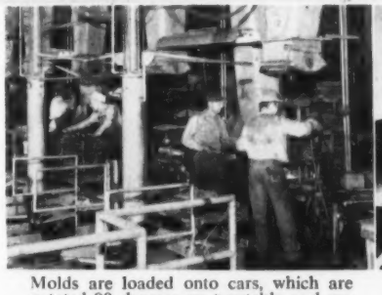
full mechanization



TWO SEPARATE SAND SYSTEMS provide the flexibility needed for production ranging from small match plate work to large, pit-molded castings. Diagram shows the closed-circuit system for storage, preparation, distribution and reclamation of fine sand and for light- and medium-weight castings.

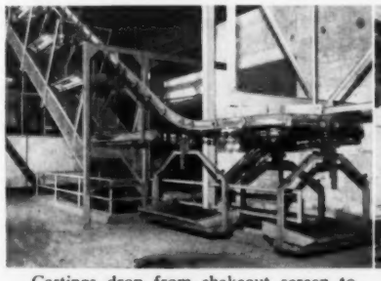
THE variety of castings produced by job shops multiplies handling problems. But the Oakland (Calif.) plant of General Metals Corp. proves that mechanization is both possible and practical. Here Link-Belt equipment—including special machinery designed specifically for this installation—speeds production of castings ranging from one pound to seven tons. Other benefits include minimized manual handling, improved working conditions.

Link-Belt engineers can plan an entire conveying and sand preparation system for you . . . and follow through with a complete line of equipment to help you produce better castings at lower cost. For one machine or complete engineering, call your nearest Link-Belt office. For complete information, write for Book 2423. 14.207



Molds are loaded onto cars, which are rotated 90 degrees on turntable and run off on tracks to pouring and storage line.

Semi-automatic device dumps sand and castings onto oscillating conveyor. Cars return by gravity to molding stations.



Castings drop from shakeout screen to trays of overhead trolley conveyor for delivery to cleaning bay.

Unique Link-Belt "Manipulator" carries up to eight tons of castings to annealing ovens, quench tanks or storage.

LINK-BELT

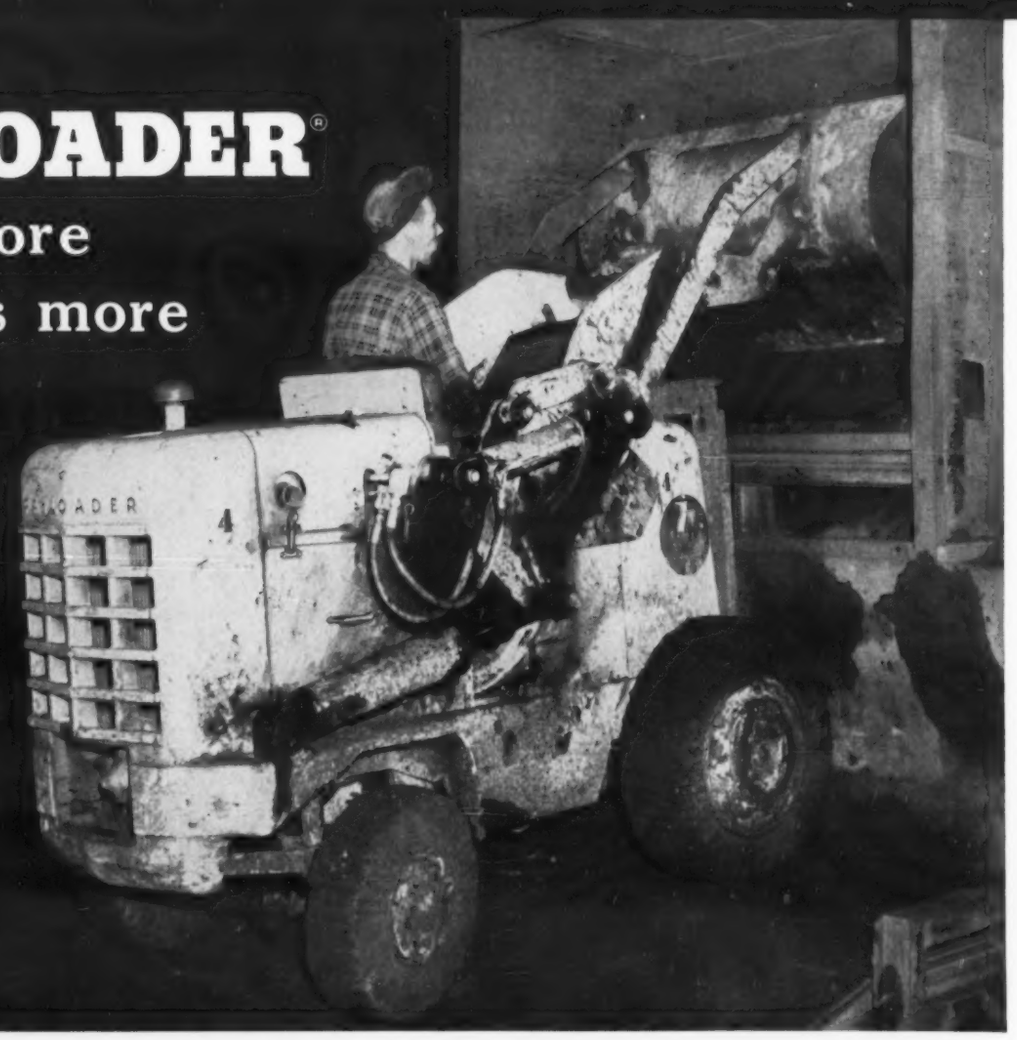
CONVEYORS AND PREPARATION MACHINERY

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

CIRCLE NO. 88, PAGE 7-8

PAYLOADER®

..does more
..endures more



What makes an HA PAYLOADER® best for your jobs?

- Shortest turning radius
- Highest dumping height
- Biggest bucket (18 cu. ft. Payload)
- Hydraulic load-shock-absorber
- 40° bucket tip-back at ground level
- Exclusive, one-lever bucket control

THE FRANK G. HOUGH CO.
711 SUNNYSIDE AVE., LIBERTYVILLE, ILL.
Send data on "PAYLOADER" tractor-shovels
☐ HA (18 cu. ft.) and HAH (1 cu. yd.)
☐ Larger models to 2¼ cu. yd.

Name
Title
Company
Street
City
State
18

A tractor shovel *has* to be good to stand up to 5,000 hours of work a year in tough foundry service. One "PAYLOADER" model HA has done it for nearly 2 years and the second for nearly a year and they are both still going strong 16 hours a day, 6 days a week at Frazer and Jones Company, Syracuse. Milton Donahue, Night Foreman, praises them in these words, "The HA torque converter model is ideal for this job. It's short, insuring excellent maneuverability, has plenty of power to work fast. The self-loading roll-back bucket design enables the operator to load from floor level. I have put the HA against all foundry jobs with outstanding production. Downtime has been very low because it's designed and built for rugged work." These HA's take up sand from pouring floor, feed sand to hopper for reprocessing, windrow sand for cutter — also handle coal and help on furnace maintenance.

Owners *expect* more from a "PAYLOADER" and *get* more because more "PAYLOADER" tractor-shovels are in service than all other wheeled tractor-shovels put together and they are backed by 35 years of tractor-shovel pioneering. There's a "PAYLOADER" size and type to fit *your* needs and a nearby Distributor ready to serve you right.

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

Input to four zones is separately controlled by infinitely variable input controller. *L & L Mfg. Co.*

CIRCLE NO. 15, PAGE 7-8

Extra! Gas-fired oven furnaces for hardening, carburizing, normalizing and annealing and drawing has 2400 F temperature range. Doors are made

of cast iron, walls made of 4½ in. refractory, backed with 5 in. of insulating brick. Units in use in foundries for burning out lost wax and preheating molds. *Eclipse Engineering Co.*

CIRCLE NO. 16, PAGE 7-8

Vacuum arc-melting furnace, German made, has interchangeable consumable or non-consumable electrodes. Handles iron, nickel, copper and many metallic carbides and borrides. Water-

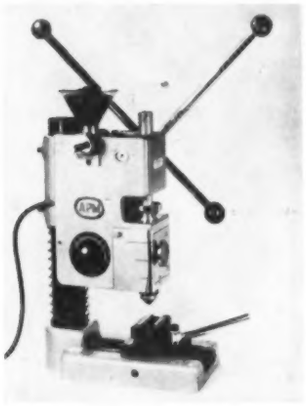
cooled, stainless steel furnace has two windows. Metal bellows permits moving of electrode head in any direction. *Rochester Div., Consolidated Electrodynamics Corp.*

CIRCLE NO. 17, PAGE 7-8

Plastic injection molding machine, bench type, hand operated, handles wide range of sizes and materials.

CIRCLE NO. 87, PAGE 7-8

Used for molding short plastic runs, developing new products and color testing. Has semi-automatic hopper



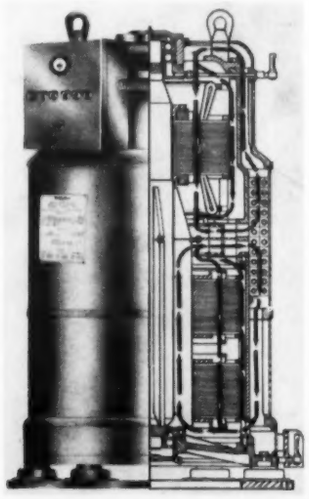
feed and leak-proof sealing and interchangeable cylinder unit. *British Industries Corp.*

CIRCLE NO. 18, PAGE 7-8

Adjustable limit plug gage checks internally from 7/16 to 2-5/16 in. and up to 5 in. deep. Usable on micro finishes. Five gages available. *George Scherr Co., Inc.*

CIRCLE NO. 19, PAGE 7-8

Extra! High frequency, vertical motor generators for induction heat treating applications have 10 to 250 kw generator ratings. Available in 1000, 3000, 10,000 cycles per second. Short

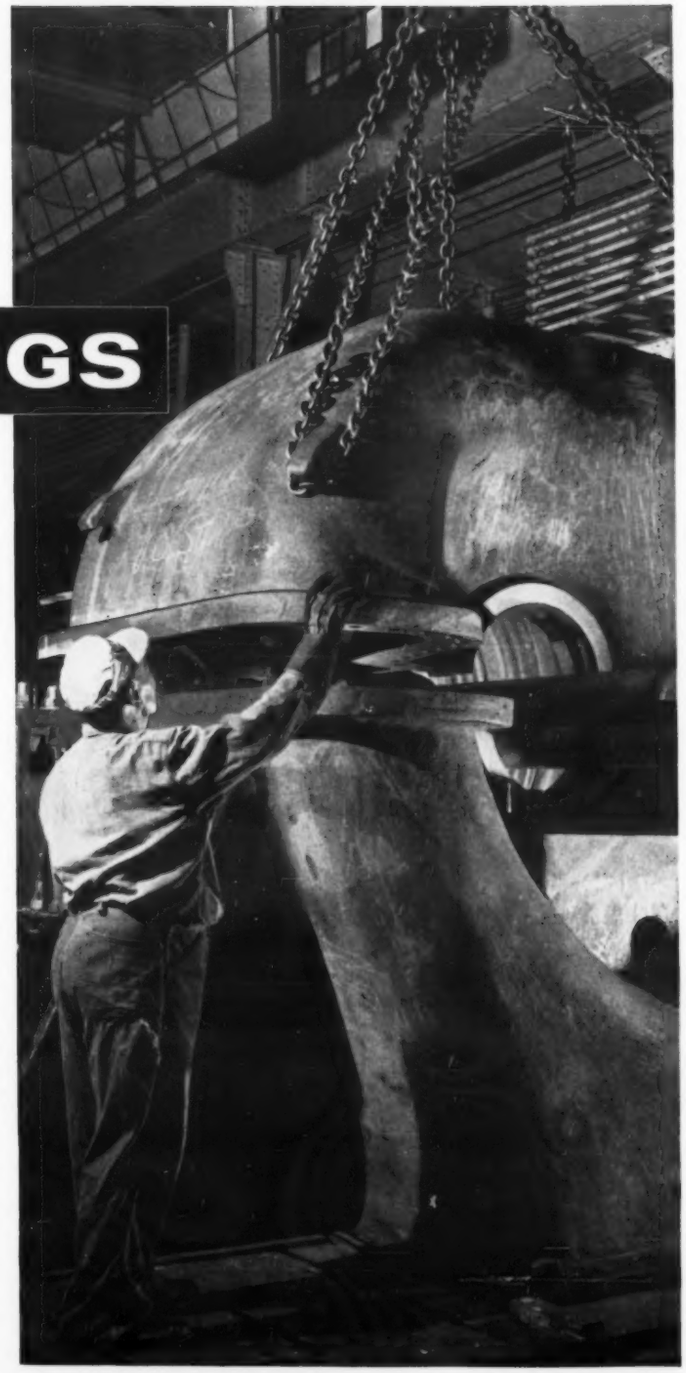


time constant of "Welduction" heteropolar designed generators gives rapid changes of power output. *Welduction Corp.*

CIRCLE NO. 20, PAGE 7-8

Oscillating spindle sander abrasive sleeves consist of tungsten carbide

Ingersoll-Rand does BIG THINGS with Hanna pig iron



Castings made in the Ingersoll-Rand foundries vary in weight from a few ounces to 30 tons. But one thing that never varies is the quality of I-R castings. For over 30 years, Hanna Furnace has been furnishing Ingersoll-Rand with ever-increasing amounts of pig iron that has the high metallurgical qualities and exact analyses required for its engineering grades of iron.

Hanna's wide product range includes the Hanna 38-lb. pig, the foundryman's favorite standard, in all grades, silvery and HannaTite, our special controlled, close-grain iron. Also the HannaTen ingot, a 10-pounder with finer grain structure and no free carbon pockets. The HannaTen also is available in all grades, silvery and HannaTite.

Our customers know that Hanna and its representatives are eager to be of service to them.

Turbine castings, totalling 55 tons, being checked in a test assembly after final machining at the Ingersoll-Rand plant at Phillipsburg, N.J.

HANNA
THE BEST KNOWN NAME IN IRON

THE HANNA FURNACE CORPORATION
Buffalo • Detroit • New York • Philadelphia
Merchant Pig Iron Division of
NATIONAL STEEL CORPORATION

CIRCLE NO. 86, PAGE 7-8

particles bonded to steel tubes. Said to prevent dishing and resist loading. Resists solvents and gasoline. *Skil Corp.*

CIRCLE NO. 21, PAGE 7-8

Toggle mechanism for small high-speed diecasting machines permits ejection over complete area of 9 x 9 in. die blocks. Die blocks have bushing supports for fitting onto pot, permitting nozzle burner flame to play on nozzle without interference from support. *British Industries Corp.*

CIRCLE NO. 22, PAGE 7-8

Grinder holding magnets lock work at 30 degree. Positions odd-shaped work as well. Magnetic force grips work without blocks, clamps or fixtures. Wound for 115 or 230 DC, hand or foot operated in three sizes. *Stearns Magnetic Products Div., Indiana Steel Products Co.*

CIRCLE NO. 23, PAGE 7-8

Synthetic wax lubricant for shell molds employing phenolic resin sand mixes, eliminates need for silicone emulsion lubricants on pattern and increases strength of green molds. Melts at 384 F. *Nopco Chemical Co.*

CIRCLE NO. 24, PAGE 7-8

Drill press, 14 in. has pivoting motor mounting plate for quick belt tension, facilitating changes. Spring-loaded plunger automatically restores correct operating tension. *Rockwell Mfg. Co.*

CIRCLE NO. 25, PAGE 7-8

Cavity blocks for die casting said to eliminate die sets, leader pins, sprews and to cut set-up time. Small blocks can be interchanged in minutes, size saves storage space. *Richards Tool & Mold Co.*

CIRCLE NO. 26, PAGE 7-8

Portable drafting unit measures 11 x 13 in. Has hard drawing surface with ¼ in. grids, adjustable ruling edge and constant tension belt. Parallel ruling possible up to 15 deg. *Lloyd Tool Corp.*

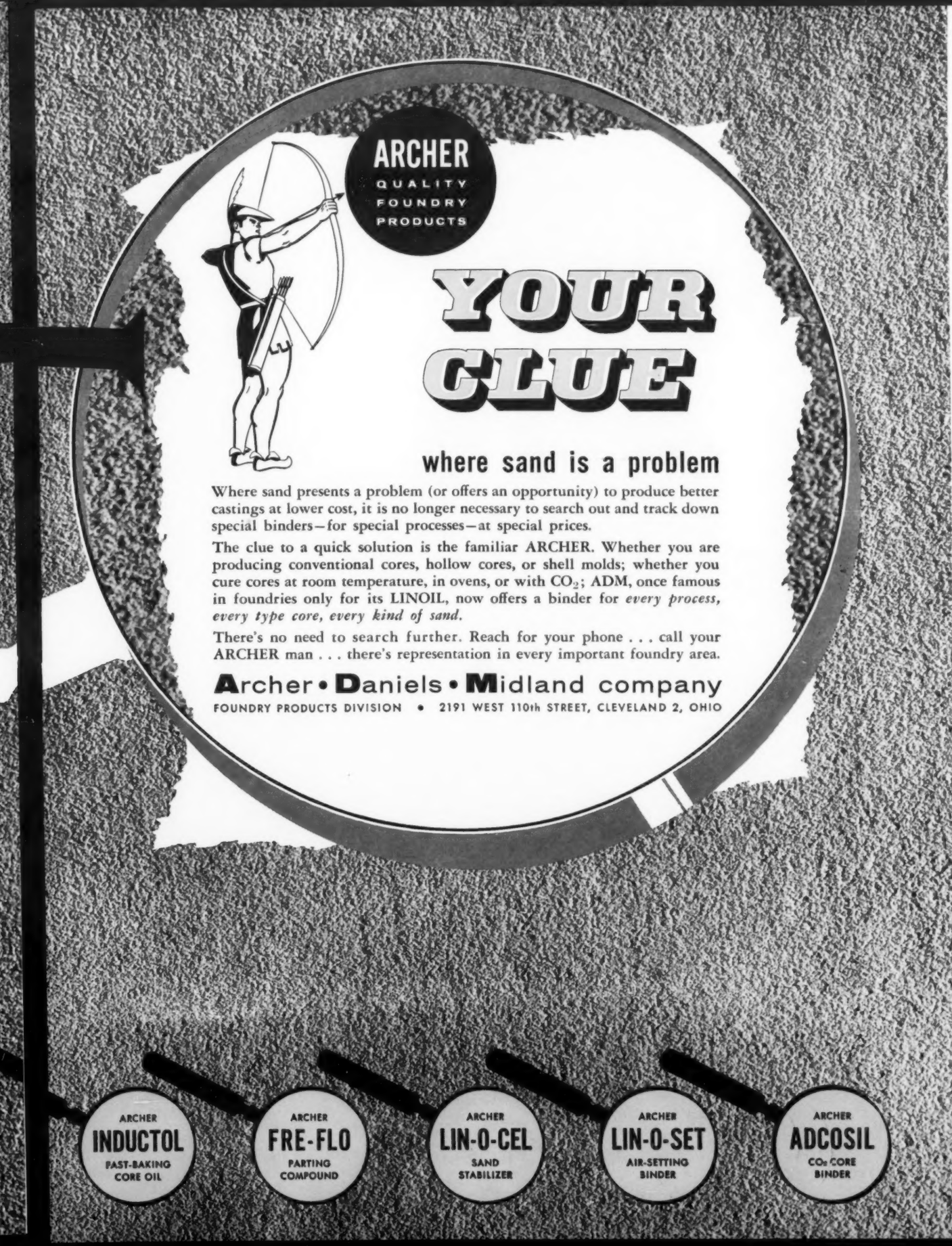
CIRCLE NO. 27, PAGE 7-8

Stopper head for ladles, made of flake graphite, fused silica and fired refractory clay is said to reduce pouring accidents and prevent spillage. Stopper head reportedly can regulate the flow as many as 50 times during a heat without cracking or spalling. *Electro Refractories & Abrasives Corp.*

CIRCLE NO. 28, PAGE 7-8

Mixing and blending free flowing

CIRCLE NO. 89, PAGE 7-8


ARCHER
QUALITY
FOUNDRY
PRODUCTS
YOUR
CLUE
where sand is a problem
Where sand presents a problem (or offers an opportunity) to produce better castings at lower cost, it is no longer necessary to search out and track down special binders—for special processes—at special prices.
The clue to a quick solution is the familiar ARCHER. Whether you are producing conventional cores, hollow cores, or shell molds; whether you cure cores at room temperature, in ovens, or with CO_2; ADM, once famous in foundries only for its LINOIL, now offers a binder for *every process, every type core, every kind of sand.*
There's no need to search further. Reach for your phone . . . call your ARCHER man . . . there's representation in every important foundry area.
Archer • Daniels • Midland company
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ARCHER INDUCTOL PAST-BAKING CORE OIL
ARCHER FRE-FLO PARTING COMPOUND
ARCHER LIN-O-CEL SAND STABILIZER
ARCHER LIN-O-SET AIR-SETTING BINDER
ARCHER ADCOSIL CO_2 CORE BINDER

bulk materials is accomplished in a metal or concrete bin containing a series of overlapping baffles which deflect out-flow to the sides of the container. Designed to produce a homogeneous mixture of bulk materials that are variable in either physical characteristics or chemical analysis in the raw state. *Hewitt-Robins, Inc.*

CIRCLE NO. 29, PAGE 7-8

Pressure gage testers available in multiple piston models cover from 1 to 6000 psi. Allow testing in small increments. Change from low to high pressure done without tools. *Amthor Testing Instrument Co.*

CIRCLE NO. 30, PAGE 7-8

Replaceable nylon face for soft striking tools is said to resist chipping, sparking or mushrooming and will not shrink in head or face bore of hammer. Also said to be unaffected by moisture, acids and oils. *Chicago Rawhide Mfg. Co.*

CIRCLE NO. 31, PAGE 7-8

Power hand tool for grinding, cutting drilling, engraving and similar uses, weighs 14 oz, operates at 25,000 rpm. Works in ferrous, non-ferrous and plastics. Used on 110 or 220 volts, 25 to 60 cycles, AC or DC. *Chicago Wheel & Mfg. Co.*

CIRCLE NO. 33, PAGE 7-8

Pallet lifter features adjustable fork bars to handle varying widths. Lifter hangs from overhead hoist and handles uniformly loaded pallets with the center of gravity of load directly under pick-up lug. Made in 2 and 3 ton capacities. *Cady Metal Fabricating Co.*

CIRCLE NO. 34, PAGE 7-8

Nonflammable solvents adaptable to vapor degreasing or cleaning by liquid immersion are said safe in open shop areas and will not harm electrical insulation. Three types are available made with boiling points from 75 to 199 F. *E. I. Du Pont De Nemours & Co.*

CIRCLE NO. 35, PAGE 7-8

Epoxy resins are colored as aid in quality control. Visual inspection will indicate completeness of mixing. Said to be non-dermatitic. Also aids in identification of parts. Available in six colors. *Furane Plastics, Inc.*

CIRCLE NO. 36, PAGE 7-8

Differential hoist has 1000 lb capacity. Use of anti-friction bearings in needed. Entirely rust-resistant. Chain lower sheave is said to reduce pull

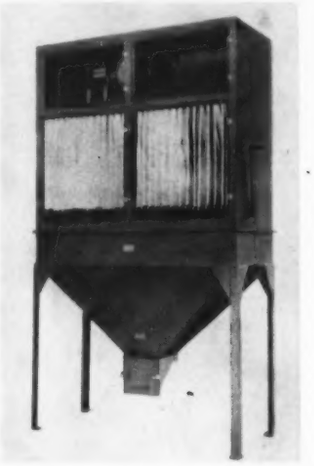
CIRCLE NO. 89, PAGE 7-8

you can really
do sand tricks
with plasti-bond
. . . yet (like the props in any trick) it's not hard to handle. You can combine high strength and toughness with flowability.
You can get maximum flowability, superior finish and easy control *plus* high strengths for easy molding, tough sand for deep pockets, low moisture for minimum defects. Sound like magic? You can get properties in sand such as you never got B.P.B. (Before *Plasti-Bond*). Read on.
Plasti-Bond gives you sand flexibility and versatility that will speed foundry operations, cut costs, improve castings and boost profits.
Not even *Plasti-Bond* can do the impossible but it comes so close to doing it, your curiosity, if not your troublesome sand problems, may lead you to get more information.
FREE—Just write for new brochure
"Sand Magic with Plasti-Bond"
EASTERN CLAY PRODUCTS DEPT.
INTERNATIONAL MINERALS & CHEMICAL CORPORATION
20 NORTH WACKER DRIVE • CHICAGO 6
Dixie Bond • Black Hills Bentonite • Revivo Bond • Plasti-Bond
Revivo Core Paste • Cupolinor • Cupoline • Taccone Molding Machines
International MINERALS & CHEMICALS
SAND MAGIC
CIRCLE NO. 90, PAGE 7-S

is 26 ft long with 7 ft lift. *Thern Machine Co.*

CIRCLE NO. 37, PAGE 7-S

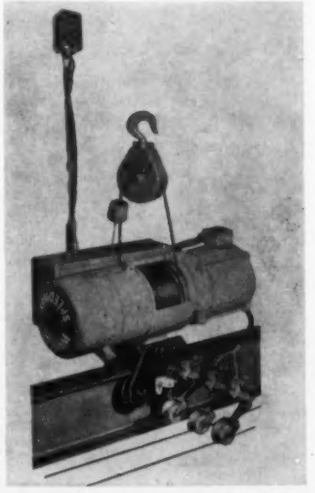
Dust collector, cabinet type, handles eight grinding wheels, 10 cu ft dust storage capacity. Five hp motor



moves 2000 cu ft of air per min at 60 mph through eight inlets. Chemically treated cloth filters are fire-retardant. *Torit Mfg. Co.*

CIRCLE NO. 38, PAGE 7-S

Electric two-speed hoist lifts and lowers on high and positions at ¼ speed. Line comes in parallel, cross,



hook, rigid or bolt mountings. Enclosed motors, AC or DC. Automatic brake immersed in oil bath. *American Chain & Cable Co.*

CIRCLE NO. 39, PAGE 7-S

Air grinder, 6 in., comes in 4500, 6000, 9000 and 12,000 rpm models with butterfly, grip and lever type. Throttle types have steel reducer

bushing for hose connections. *Thor Power Tool Co.*

CIRCLE NO. 40, PAGE 7-8

Barrel finishing abrasive spheres come in five different sizes of aluminum oxide. Designed for working intricate

shapes and difficult recesses. Said to be exceptionally dense and long lasting. *Norton Co.*

CIRCLE NO. 161, PAGE 7-8

Stripper flasks and jackets, aluminum, have corner opening. Made in widths to 48 in., lengths of 64 in. Quick-

release flasks come in standard and special shapes. *General Foundry Service Corp.*

CIRCLE NO. 162, PAGE 7-8

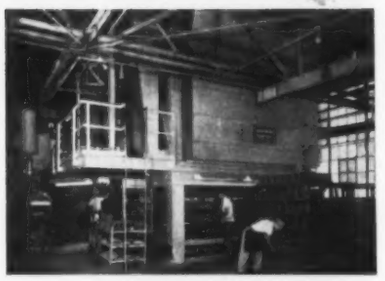
Hydraulic testing machine has 30,000 lb capacity. For research testing on

castings. Handles ceramic, concrete, wood and plastics. Clearance of 12 x 18 in. *Soiltest Inc.*

CIRCLE NO. 163, PAGE 7-8

COLEMAN OVENS

turn minutes into money...



Coleman Tower® Oven

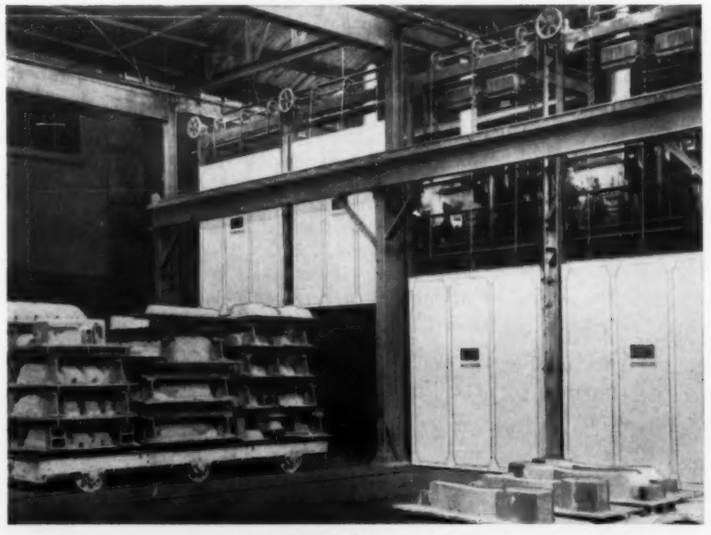
Fast, efficient production of uniformly good cores and molds is vitally important to foundry profits.

When you use old, out-dated core and mold ovens the minutes and hours lost in costly rejects and make-overs . . . the time and effort lost in wasted man power, the production lost in casting scrap eat your profits away. Modern design and exclusive advantages of Coleman Ovens result in immediate production economies, reducing overall core department costs by as much as 50%! Such savings mean increased profits and rapid investment amortization.

More than half a century of specialized foundry oven experience is your assurance that the Coleman Oven recommended to you will do your work to your complete satisfaction. ***As builders of the world's only complete line of foundry ovens we have no reason to recommend any but the best for your purpose.*** Let our experienced engineers give you practical suggestions for your particular requirements.

WRITE FOR BULLETIN 54

Coleman Transrack Ovens



Coleman Car-Type Core Ovens

Coleman Dielectric Oven

A COMPLETE RANGE OF TYPES AND SIZES . . .
for every core baking and mold drying requirement:
Tower Ovens • Horizontal Conveyor Ovens
Car-Type Core Ovens • Car-Type Mold Ovens
Transrack Ovens • Rolling Drawer Ovens
Portable Core Ovens • Portable Mold Dryers
Dielectric Core Ovens

THE FOUNDRY EQUIPMENT COMPANY
1825 COLUMBUS ROAD CLEVELAND 13, OHIO

WORLD'S OLDEST AND LARGEST FOUNDRY OVEN SPECIALISTS

CIRCLE NO. 93, PAGE 7-8

First with —
BETTER METAL ABRASIVES FOR *Blast-Cleaning*

For 70 years Pittsburgh Crushed Steel Company has developed better metal abrasive through exhaustive research and has maintained its leadership by continuing research and improvement.

A complete line of steel malleable and standard chilled iron shot and grit.

NOW IN 50-LB. *Double Burlap* BAGS

Sold and Recommended by PANGBORN CORPORATION Hagerstown, Md.

- **Samson Shot and Angular Grit** — The original chilled iron metal abrasives that led to the conversion from sand to metal abrasives for blast cleaning. Still accepted today as the best.
- **Malleabrasive** — The original patented malleablized type of metal abrasive of greater toughness and longer life. Still leads the field.
- **Tru-Steel Shot** — The original super-tough, heat-treated and drawn shot of tool steel quality. Now the pace setter in production of the all-steel type of shot.

Packed in handy 50 pound reinforced burlap bags — easy to handle — speeds unloading of truck and handling within the plant.

PITTSBURGH CRUSHED STEEL CO.
Arsenal Station, Pittsburgh 1, Pa.

Subsidiaries:
Globe Steel Abrasive Co.
Mansfield, Ohio
Steel Shot Producers, Inc.
Butler, Pa.

METAL ABRASIVES FOR EVERY NEED

CIRCLE NO. 92, PAGE 7-8

let's get personal

Kempton Dunn . . president of American Brake Shoe Co., has been elected chief executive of the firm. **Wm. B. Given, Jr.,** who has been chief executive will continue actively as chairman of the board. Dunn was elected president of Brake Shoe in 1954 and has been with the company since graduation from college in 1932. During the 27 years that Given has served as president and chairman, Brake Shoe has changed from a manufacturer of railroad equipment to a producer of products for many industries.

Frank M. Robbins, Sr. . . has gone fishing. He has retired as president of Ross-Meehan Foundries, Chattanooga, Tenn., after a career of 45 years in the foundry industry. He is a member of AFS, past president of SFSA, and had been awarded the SFSA Lorenz medal. He will continue as a member of the firm's board of directors with the title of executive consultant. His successor as president is **J. C. Lucas,** former consulting engineer for Meehanite Metal Corp.

Hugh Pope . . vice-chairman of the AFS Connecticut Chapter has assumed the duties of chapter chairman following the resignation of **A. E. Rowe** who resigned due to the press of business.

American Steel Foundries has reported the retirement of two of its executives. **John W. Porter,** assistant vice-president, has retired after more than 41 years with the company. At the time of his retirement he was located at the firm's manufacturing research labs in East Chicago, Ind. **Chester H. J. Walcher,** former works manager of the Granite City, Ill., works has retired after more than 48 years service.

William C. Rowland . . has been appointed foundry superintendent for Alten Foundry & Machine Works, Inc., Lancaster, Ohio. He succeeds **Val "Pete" Young** who has retired. Rowland has served as assistant superintendent since 1952.

Robert Newtson . . has been named production manager for GMC's Central Foundry Division, Danville, Ill., plant. He was previously the divisional auditor with headquarters in Saginaw Mich.

R. B. Courchene . . director of industrial relations for the Dayton Malleable Iron Co., Dayton, Ohio, has been elected a vice-president of the company.

Adirondack Foundries and Steel, Inc., Watervliet, N.Y., has announced a series of executive appointments. **C. M. Apgar** has been promoted from works manager to vice-president in charge of operations. **C. L. Richards** has been promoted from chief metallurgist to vice-president in charge of

J. W. Porter

W. C. Rowland

R. B. Courchene

metallurgy and research. **F. E. Ziter** has been promoted from manager of sales to vice-president in charge of sales and **N. B. Akitt** moves from the chief engineer's post to become vice-president in charge of engineering.

Jules J. Henry . . has joined Lavelle Gray Iron Foundry Corp., Anderson, Ind., as director of quality control.

C. F. Isonhart

Carl F. Isonhart . . has joined Thiem Products, Inc., as a representative in Michigan.

Donald M. McGrath . . has been named manager of the San Diego plant of Solar Aircraft Co. He was previously general manager of the Utica division of Bendix Aviation Corp.

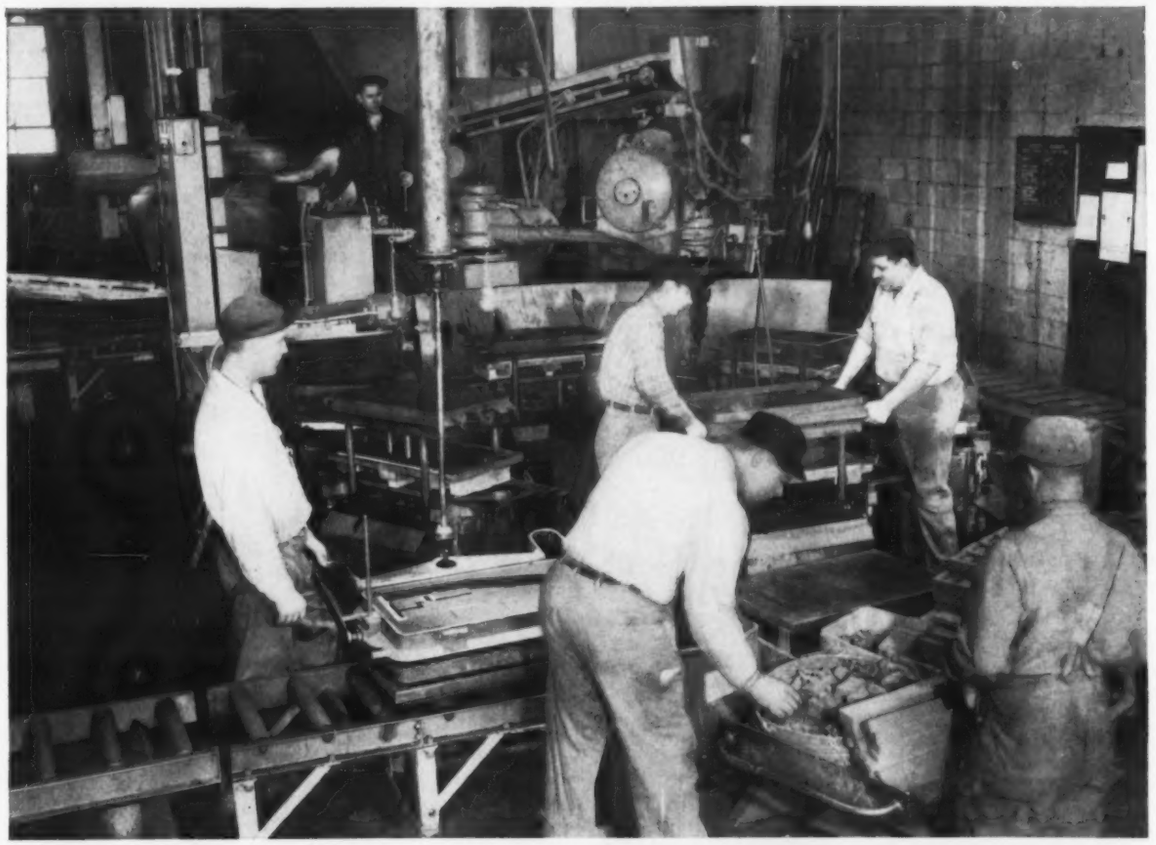
AFS Sand Division Basic Concepts Committee (8-V) has elected new officers following the resignation of the committee chairman, **C. E. Wenninger. V. M. Rowell** has been elected chairman and **J. B. Caine** has been elected vice-chairman.

O. G. Specht, Jr.

O. G. Specht, Jr. . . has been appointed Detroit district manager for Electro Metallurgical Co. He joined Electromet in 1952 after having been employed at Grede Foundries, Inc.

National Malleable and Steel Castings Co., Cleveland, has announced the appointment of **Frank J. Mitchell**

There's a slinger unit designed for every job



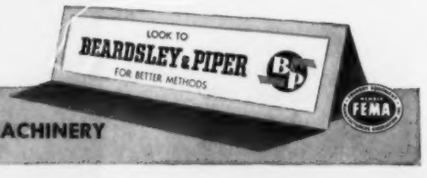
A CASE STUDY at the Detroit Stoker Company, Monroe, Michigan where this Hydra-Slinger Roto-Mold Unit handles many of the foundry's medium size production and semi-production patterns on an efficient production cycle.

Two efficient molding units—each built around a slinger — have recently been installed at the Detroit Stoker Company, Monroe, Michigan. One unit, with Hydra-Slinger, B & P Roto-Mold turntable and six B & P Speed-Draw Machines, handles the foundry's production and semi-production work. The other unit with Sandslinger and B & P Rol-A-Draw rollover draw machine handles the jobbing work.

Both units are ideally adapted to the range of work handled, and both have contributed greatly to the overall success of this foundry. This plant offers an excellent example of how slinger mechanization can meet greatly varying requirements.

There are slinger units designed for every job—from loose pattern jobbing work to highest production repetitive production work. Bulletin 320 has all of the facts . . . send for your copy today. Beardsley & Piper, 2424 N. Cicero Ave., Chicago 39, Illinois.

LARGER JOBBING WORK at Detroit Stoker is rammed by this Stationary Sandslinger served by roller conveyor. These molds are rolled over and drawn on a B & P 920 RCX Rol-A-Draw rollover draw machine.



THE WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF FOUNDRY MACHINERY

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as consultant and of **Walter W. Matzke** as assistant manager, technical services, railway division. Both will work closely with the railroads, car and locomotive builders.

AFS Sand Division Core Test Committee (8-C) has elected as chairman **Wm. M. Peterson,** and as vice-chairman, **C. J. Jelinek.**

General Electric Co.'s Foundry Department has announced the reorganization of its engineering section to establish a product engineering function at each of its four foundries. The new product engineering managers and their locations are: **J. W. Clarke,** Erie; **A. B. Steck,** Everett-Lynn; **R. D. Ahles,** Schenectady; and **J. T. Coggin,** Elmira. All are members of the American Foundrymen's Society.

Robert E. Ward . . has been named director of manufacturing of the New York Air, Brake Co. For many years Ward was with Bendix Aviation Corp. as director of metallurgy, foundry manager, and manager of special services.

The Carborundum Co. has announced a series of promotions and appointments to fill posts in its expansion. **John F. Claydon,** formerly sales manager of the coated abrasives division is now division general manager and **H. P. Dales** has been promoted to division sales manager. In the bonded abrasives division, **Fred Bonacker,** former sales manager and assistant vice-president, has retired and **F. W. Scott** has been named sales manager. **Arthur A. Turner** has been promoted to sales manager of the refractories division.

George E. Tate . . treasurer of Federal Foundry Supply Co., Cleveland, has been named to the company's board of directors.

George H. Skirven . . has been named resident sales manager for Pennsylvania Foundry Supply and Sand Co. in the states of Virginia, North Carolina, South Carolina and West Virginia. His headquarters will be in Alexandria, Va.

Peter Humont . . has joined the staff of the Miller Co., Chicago office. Until recently he was associated with Texas Foundries, Inc., Lufkin, Texas.

Lindberg Engineering Co., Chicago, has named two for new posts with the firm. **John R. Duffy** has been appointed chief engineer and will direct

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OSBORN Vibrating-Squeeze Machines have a simultaneous vibrating-squeeze action which results in a superior flow of sand. Consequently, molds are hard and uniform . . . have clear cut impressions of fine detail. Production is increased because the separate jolt operation is eliminated.

These vibrating-squeeze machines are ideal for a wide variety of intricate castings, particularly where fine detail, good finish and accurate cast dimensions are required.

An Osborn Foundry Specialist will gladly recommend the proper machine for your particular applications. Write *The Osborn Manufacturing Company, 5401 Hamilton Avenue, Cleveland 14, Ohio.*

Leader in mechanization for the foundry

OSBORN®

CORE BLOWERS
MOLDING MACHINES
INDUSTRIAL BRUSHES

MEMBER FEMA

engineering and design functions. **D. R. Grandy** has been named as engineering and technical consultant for the firm's Cleveland division office.

Earl Hottel . . has been named to head of newly established service and parts department of Lectromelt Furnace Co., Pittsburgh. The department will handle all customer services for the company.

John F. Zaman . . has been appointed sales engineer for Osborn Mfg. Co. He was formerly employed in the company's research and development activities.

Frank G. Hough Co., Libertyville, Ill., has named **Robert L. Knox** and **Herman R. Brown** as assistant sales managers.

John F. Wisniewski . . has joined the Chicago office of C. O. Bartlett & Snow Co. as foundry sales and layout engineer.

Roland L. Jandron . . has been appointed a field engineer at Norton Co.'s Los Angeles District office. He was formerly at the firm's Chicago office.

Clyde Pence . . has been promoted to the newly created position of director of research and product development for the Asbury Graphite Mills, Inc., Asbury, N.J.

Max C. Farmer . . has been appointed to the new post of technical director of the Beryllium Corp., Reading, Pa.

Kenneth G. MacDonald . . has been appointed product sales manager of furnaces and associated equipment in the General Electric Co.'s industrial heating department.

R. D. Baker, Jr. . . has been promoted to the position of assistant sales manager of the coke and iron division of Pittsburgh Coke and Chemical Co.

Semet-Solvay Division, Allied Chemical & Dye Corp. has appointed **Frank M. Norton** as vice-president and **H. E. Imes** as director of operations.

H. K. Porter Co., Inc., has elected **T. M. Evans** as chairman and **C. L. Holbert** a president.

Robert J. McCarthy . . has been appointed as general manager of the Atlantic division of Mexico Refrac-

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Coremaker cures larger core with portable CO_2 unit, using 50-lb. pressure. Cores are firm, easy to handle.

Cured cores ready to be taken to the metal pouring lines. Specially prepared core sand feeds through chute (left). Sand is hand-tamped into molds. Then CO_2 from jet (center) is shot into molds.

"New sodium silicate-CO_2 process cut our coremaking cost 21% and improved core quality"

—says HANS JACOB, Foundry Supt., Lehigh, Inc., Easton, Pa.

Intricate cores (above) and large cores and molds (below) are economically made and cured in only 2 to 3 minutes. Because no stockpiling of cores is necessary, core room runs as an integral part of the pouring line.

"Since we began using the sodium silicate-CO_2 process, coremaking has been much more efficient and economical," continues Mr. Jacob. "Pasting and mudding costs have been eliminated, and an over-all saving of 21% has been achieved. Hot tears and cracks, and 'lost' tolerances have been decreased, too. And the men in the shop like the new technique because it has no objectionable gases or fumes.

"Production is faster with the sodium silicate-CO_2 process. Most cores are used the same day they are cured," Mr. Jacob concludes.

High-quality Du Pont sodium silicate is available in formulated products for CO_2 systems from foundry supply houses throughout the country.

If you're thinking of adapting the new sodium silicate-CO_2 process to your operation, a Du Pont technical representative will be glad to discuss the process with you.

E. I. DU PONT DE NEMOURS & CO. (INC.)
Grasselli Chemicals Department, Wilmington 98, Delaware

DU PONT REG. U.S. PAT. OFF **SODIUM SILICATE**

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

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as head of the wholesale firm, Missouri Refractories Co., Los Angeles.

Paul A. Mori . . has been named executive vice-president of the Cleveland Quarries Co., Amherst, Ohio. He has been with the company since 1911.

William D. Signer, Jr. . . has been appointed service engineer at the Rochester offices of Acheson Colloids Co., Rochester, N.Y.

James G. Henzel, Jr. . . has been appointed an applied research engineer for General Electric Co.'s foundry department applied research and development labs.

Osborn Manufacturing Co. has announced a series of promotions in its sales and engineering functions. **E. B.** Smith has been promoted from assistant manager to sales manager. **E. K. Hatch,** former assistant chief engineer, is now assistant manager of the machine division. **E. H. Brauer** replaces Hatch as assistant chief engineer.

Gunite Foundries Corp., Rockford, Ill., has named a new chairman and a new president. **D. P. Forbes,** immediate past president, becomes chairman, and **E. C. Fales,** executive vice-president, moves into the presidency.

Clifford J. Sheehan . . eastern sales manager of Alcoa's die casting division, has been named president of the American Die Casting Institute following the resignation of W. J. During.

William Rostoker . . has been promoted to assistant manager of the metals research department at Armour Research Foundation of Illinois Institute of Technology, Chicago. He will be in charge of the applied metallurgy, foundry and steelmaking, physical metallurgy, and welding sections.

Robert A. McCune . . has joined the staff of the metallurgy division of the Denver Research Institute.

Pangborn Corp., Hagerstown, Md., recently welcomed eight new members to the firm's Quarter Century Club at the sixth annual reunion of the club. Eight new club members were presented engraved watches by Thomas W. Pangborn, company president. The new members are: M. E. Fahrney, A. W. Shupp, J. R. Wagner, C. H. McKinsey, L. H. Baker, A. F. Rodgers, G. S. Bowers, and A. L. Gardner.

Southeastern Chapters to Hold Regional Feb. 21-22

Ten technical speakers will address the 25th Southeastern Regional Foundry Conference to be held Feb. 21-22 at the Tutwiler Hotel, Birmingham, Ala. The conference is sponsored by the Birmingham and Tennessee Chapters and the University of Alabama Student Chapter of the American Foundrymen's Society. Sam F. Carter, Jr., American Cast Iron Pipe Co., and

S. F. Carter

Vice-Chairman of the Birmingham Chapter is in charge of arrangements.

Thursday morning two speeches will be presented *"Some Sand, Some Metal, Some Man-Made Defect"* by C. A. Sanders, American Colloid Co.; and *"Cost Control Methods in the Foundry"* by C. E. Westover, Westover Engineers, Inc. At the luncheon, talks will be made by AFS national officers.

In the afternoon, T. O. Mahaffey, Kish Resins, Inc., will present *"Epoxy Resins in Pattern Applications;"* Harry Kessler, Sorbo Mat Process Engineers, will discuss *"Gating and Risering"* and R. C. Ortgies, American Air Filter Co., will talk on *"Air Pollution Control Equipment for Cupolas."*

Friday's program will begin with plant visits. The technical sessions will start with *"Production Experience with Carbon-Dioxide Cores"* by Frank Scaggs, Oklahoma Steel Castings Co., followed by *"Operating a Basic Water Cooled Cupola"* by A. P. Alexander, International Harvester Co. and *"Common Sense in the Coreroom"* by Warner B. Bishop, Archer-Daniels-Midland Co.

Two talks will be made at non-ferrous sessions, *"Highlights of Modern Brass and Bronze Foundry Practice"* by H. M. St. John, consultant and *"Brass Melting Practice"* by F. L. Riddell, H. Kramer Co.

Harry Stuhldreher, United States Steel Co., will speak at the Friday night banquet.

A ladies program will be held including a luncheon and fashion show.

He has to see for himself!

When it comes to blast cleaning, a foundryman can't believe claims and promises. He has to see for himself the kind of cleaning job an abrasive does. His next question is: What does it cost in operation? Different jobs may require different abrasives but the result should always be the same—the *best* job at *lowest cost.* Malleabrasive and Tru-Steel abrasives give you that. Whichever you need, Pangborn has the right abrasive for your job. Talk to one of our sales engineers or write PANGBORN CORP., 1300 Pangborn Blvd., Hagerstown, Maryland.

Pangborn DISTRIBUTORS FOR **MALLEABRASIVE®** AND **TRU-STEEL SHOT**

3A

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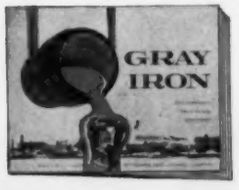
Send for Your Copy of This Free
GRAY IRON BROCHURE



An illustrated brochure on the Gray Iron Industry and its place in the nation's industrial economy. Includes descriptive data on casting practices and the story of the production of Neville Pig Iron and Neville Foundry Coke.

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

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Discuss Castings' Future At AFS Michigan Regional

■ A program built around the theme —New Casting Processes and New Fields for Castings—attracted over 300 foundrymen to the AFS Michigan Regional Foundry Conference at Ann Arbor, Nov. 29-30.

In keeping with the professional interests of this group many of the talks involved the automotive industry. One of these, "Casting's Future in the Automobile of Tomorrow" was presented by M. F. Garwood, Chief Materials Engineer, Engineering Division, Chrysler Corp.

An example of the changing times was demonstrated in a movie and

Taking break at Michigan.

talk by E. E. Braun, Central Foundry Div., GMC. Braun described their new Danville Foundry where crankshafts are being made in shell molds with a new type pearlitic malleable containing boron and bismuth. Foundry automation has reached a new high in this plant. The materials and the castings are handled almost entirely by mechanical devices.

Looking even further into the future, D. F. Frey, Ford Motor Co., described the gas turbine and free piston type automobile engines. Aluminum castings are being used for the compressor, compressor turbine, drive turbine, and casing around the turbine. High alloy steel precision castings are used for the gas turbine blades. The speaker did not visualize any wide scale use of these advanced design engines in the next ten years.

Better quality and control over cast iron have led to increased use of the versatile water-cooled cupola – nicknamed by the automotive people as the cupola with fluid-drive. W. Dawson of Ford Motor Co. described the operation of their 102 inch cupola, largest water-cooled in this country.

L. J. Pedicini, GMC, described the advantages of diaphragm molding and the use of an exhaust blower to pull the diaphragm up into the air chamber when mold is being removed. Superior results have been obtained by using an oversize diaphragm.

The production of an improved pearl-

itic malleable iron by increased additions of sulfur, was described by E. F. Chojnowski, Albion Malleable Iron Co. The graphite appears as true spherulites instead of the conventional popcorn form and a spheroidized cementite matrix is produced in heat treatment.

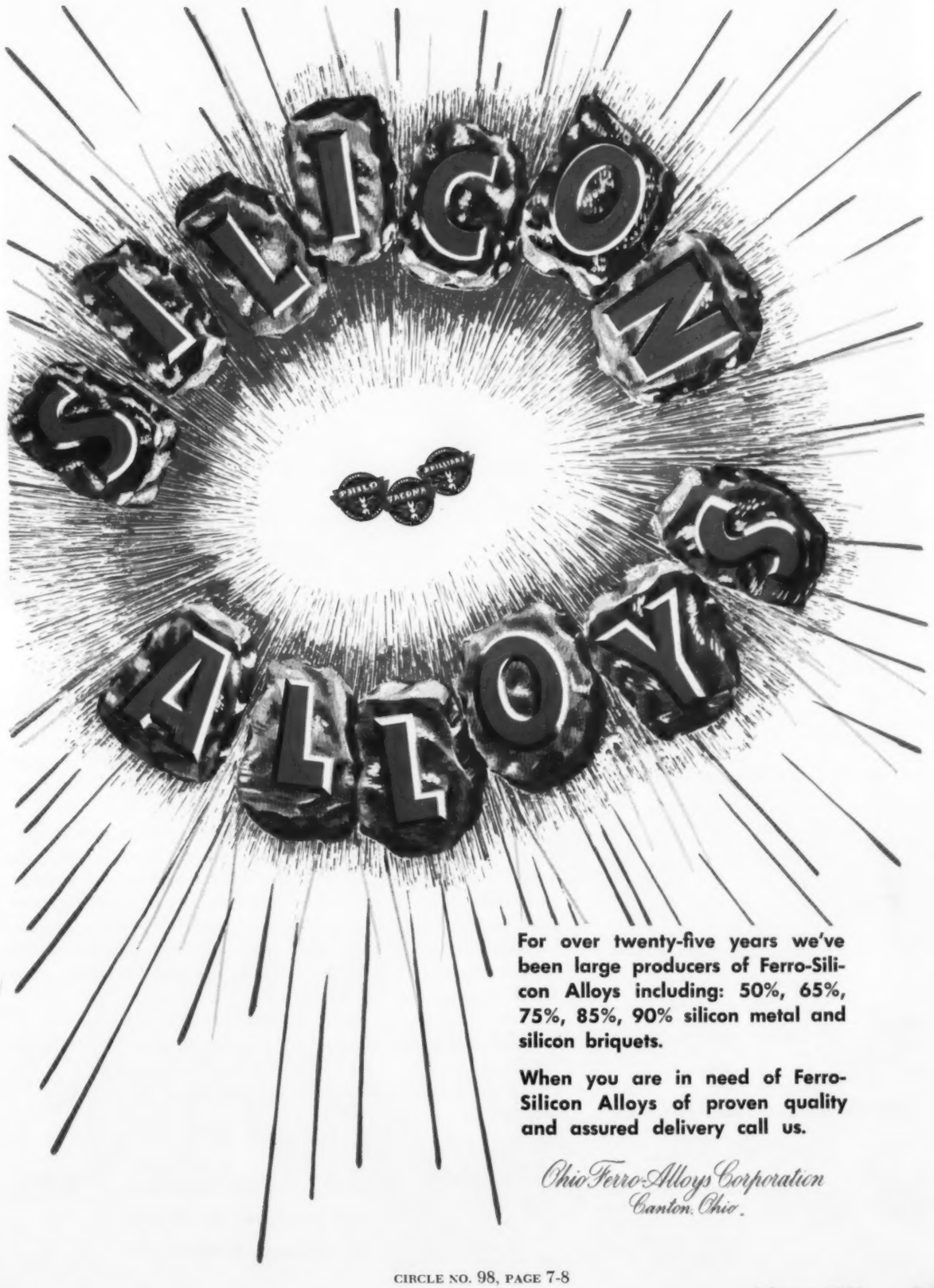
W. H. Buell, Aristo Corp., spoke on the subject of core oil testing. He recommended the tensile test as most indicative. In evaluating an oil duplicate tests should be made using a standard core oil for comparison. A variety of test temperatures and times give a better indication of performance to be expected.

"Aluminum alloys must be poured carefully in a non-turbulent manner to prevent trapping of air and creating oxide inclusions" according to R. A. Colton, Federated Metals Div., American Smelting and Refining Co., in his talk on modern non-ferrous foundry practice.

C. J. Freund, dean of the College of Engineering, University of Detroit, life member of AFS, cautioned the foundrymen to keep abreast of technological changes even to the point of going back to school on a part-time basis. He cited many examples of companies that either prospered or fell by the wayside because of their attitude toward trends and changes.

"Manpower Maintenance" was the subject of a talk by H. E. Gravlin, Jr. of the Claude B. Schneible Co. C. L. "Biggie" Munn, Athletic Director, Michigan State University, talked on "What It Takes" to get along in life. Wm. W. Maloney, General Manager, AFS, announced the establishment of the new AFS Training and Research Institute and proposed construction of a Foundry Training Center.

Make it any way you like.



For over twenty-five years we've been large producers of Ferro-Silicon Alloys including: 50%, 65%, 75%, 85%, 90% silicon metal and silicon briquets.

When you are in need of Ferro-Silicon Alloys of proven quality and assured delivery call us.

Ohio Ferro-Alloys Corporation
Canton, Ohio

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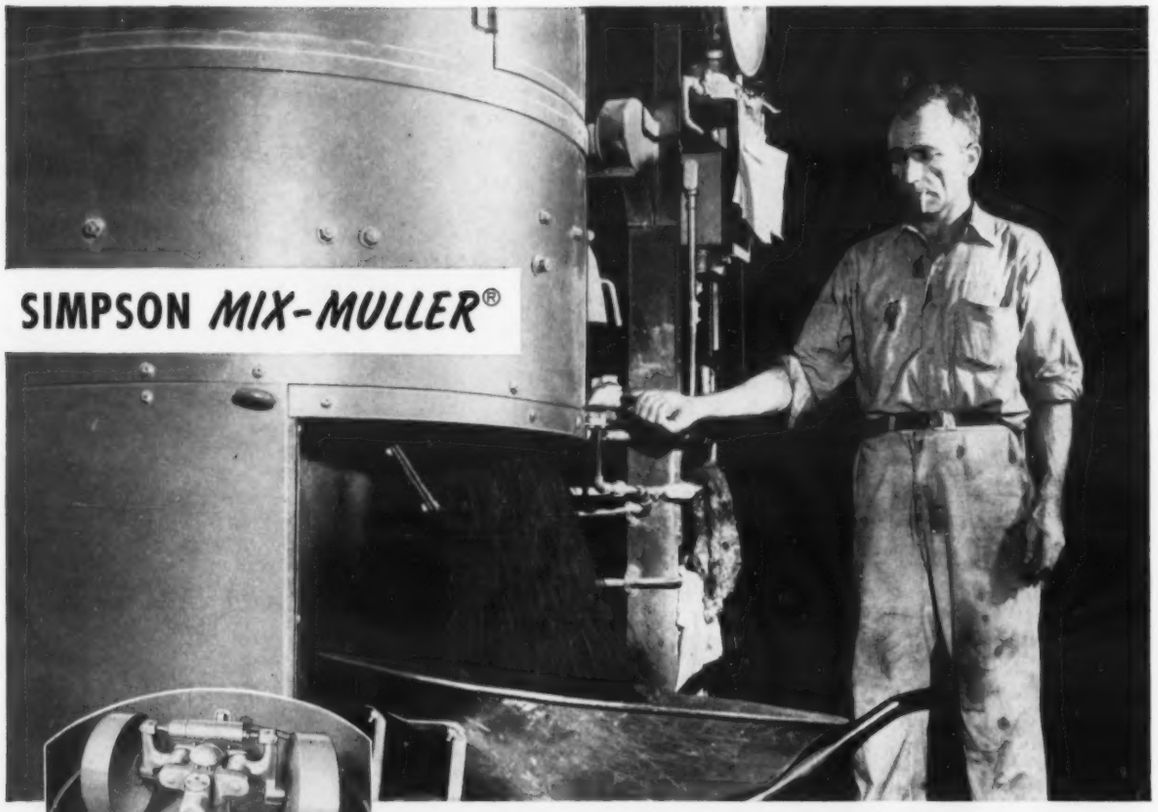
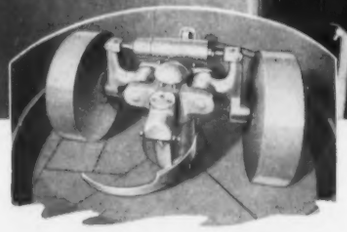




THESE FEATURES
make sense to foundry men:

LOW POWER REQUIREMENTS

Stationary pan principle brings mulling action *to the sand mass.* Power used—is used to mix sand.

EASE OF MAINTENANCE

Simple, rugged design makes Simpson Mix-Muller safe and easy to operate, *understand,* and maintain.

UNIFORM CONTROLLED MIXING

An *intensive* muller, the Mix-Muller provides thorough dispersion, even tempering for any and all types of sand used in the foundry, including CO_2.

BOTTOM DISCHARGE

empties pan quickly, thoroughly, automatically

To discharge any model of the Simpson Mix-Muller all you do is open a door in the bottom of the pan. The mixer is emptied quickly, (up to 4,000 lbs. in 20 seconds) and *thoroughly* by plow action. No extra power is needed to elevate the sand.

Simplicity is inherent in the design of the Simpson Mix-Muller. *Any* machine that pays off in a foundry operation must be rugged, easy to clean . . . easy to *get at* for routine maintenance and lubrication. Simpson Mix-Mullers have been filling these basic requirements for over 45 years. The newer F Series Models provide centralized lubrication, V-belt drive; a removable crib section for easy access combined with the most thorough, controlled mulling action ever developed!

They are described in Bulletin 511 and are available now in a range of sizes from 50 to 4,000 lbs. batch capacity. Write for details today.

Mixing and the integration of mixing equipment—is our business.

NATIONAL Engineering Company
630 Machinery Hall Bldg.,
Chicago 6, Illinois

CIRCLE NO. 99, PAGE 7-8

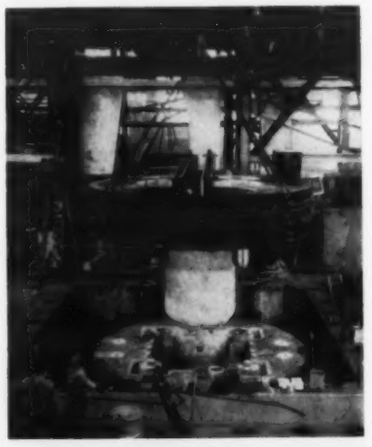
Castings Proof of Canada's Industrial Independence

Three castings, each weighing over 150,000 lb, have been produced recently by Canadian Steel Foundries (1956) Limited, Montreal. These castings, the largest ever produced in Canada, are units of a 16,000 ton,

Cylinders weighing 150,000 lbs were designed in the U.S. but constructed, machined and cast by Canadian firms.

three-unit, hydraulic O-ing press for forming welded steel pipe.

Thirty pipes will be produced hourly, each 40 ft long with diameters ranging up to 31 in. and half an inch in thickness. This will eliminate Can-



Fitting the 12-ton center core into the cope required considerable skill. Men at molding pit indicate size.

ada's dependence upon imports for pipe of this size.

The cylinders cast by Canadian Steel were designed by Verson Steel Press Co. of Chicago and will accommodate pressures in excess of 3000 psi. Canadian Allis-Chalmers performed the percision machinery and Montreal Locomotive Works Ltd. did the actual construction.

pouring off the heat

thank you

■ Please accept our thanks for the cooperation extended the Japanese Gray Iron Foundry Productivity Team during its visit to your offices on October 11.

I need not tell you that the team was most impressed with the visit as a whole for this must have been evident to you. They counted the visit to your offices as an extremely important one for them. The proof of this was certainly demonstrated in the many purchases of books they made while visiting with you.

I am certain that some day we will be working with you again and I shall look forward to seeing you on future occasions.

JOHN J. CAPECE, Project Manager
Office of Industrial Resources

how about it?

■ As apprentice patternmaker with the Acme Pattern Works in Berkeley, Calif. I sometimes wonder why you seem to give so little attention to the pattern-making branch of the foundry industry in your magazine?

BILL, the Apprentice Boy

We would like to print more material about patternmaking, Bill, but can't do it unless you patternmakers do some writing. At least send us some pictures of what you are doing and we will write the story. Watch for the March Bonus Section! It will be all about plastic patterns and core boxes.

touche'

■ So you have fallen heir to the time-worn blunder of saying "ac or dc current"—page 19 of December MODERN CASTINGS. This expression, when spelled out, simply means alternating current current or direct current current. Isn't it enough to say simply ac or dc?

JOHN PAUSTIAN
Asst. Professor of
Mechanical Engineering

Let that be a lesson to us. But who got famous saying "a rose is a rose is a rose?"

MORE FACTS on all products, literature, and services shown in the advertisements and listed in Products & Processes and in For the Asking can be obtained by using the handy Reader Service cards, pages 7-8.

There goes another furnace into the Keokuk "tepee!" The Chief, Princess Wenatchee and Junior are mighty busy preparing for the future. Seriously, big things are going on at both our Keokuk and Wenatchee plants. Demands for Keokuk Silvery Pig Iron, silicon metals—other ferroalloys have been considerable (we are happy to say) and this calls for 2½ million dollars worth of expansion and modernization. In fact, we are now installing several huge ferro-alloy electric furnaces, one of which, we believe, is the largest of its kind ever to be built. This will provide added capacity and along with new materials handling systems and other types of equipment, continued efficiency, quality of product and prompt service will be assured. This, we feel sure, is of interest to all our customers.

KEOKUK ELECTRO-METALS COMPANY

Keokuk, Iowa
Wenatchee Division, Wenatchee, Washington

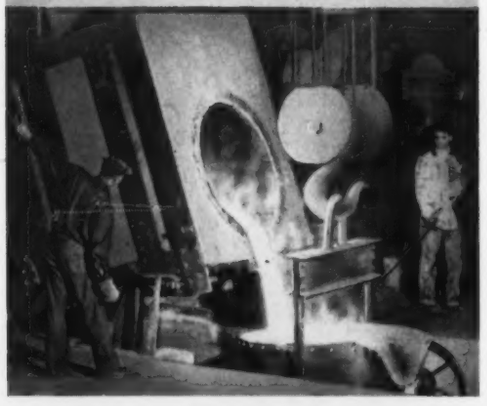
KEOKUK SILVERY PIG IRON
SILICON METAL—OTHER FERROALLOYS

SALES AGENT: MILLER AND COMPANY
332 S. Michigan Ave., Chicago 4, Illinois
3504 Carew Tower, Cincinnati 2, Ohio
8230 Forsyth Blvd., St. Louis 24, Missouri

Keokuk Silvery Pig is the superior form of silicon introduction for foundries and steel plants. Car for car and pig for pig, it never varies in quality or content. Keokuk can be handled by magnet and charged by weight or piglet count. Available in 60 pound and 30 pound pigs and 12½ pound piglets. Leading aluminum producers specify Keokuk Silicon Metal for uniform high purity.

CIRCLE NO. 100, PAGE 7-8

. . . cast by
SANDUSKY
. . . melted in
AJAX Furnaces

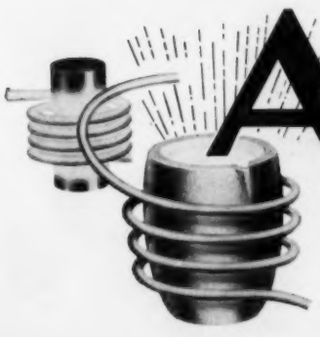


Here, at Sandusky Foundry and Machine Co., is Ajax induction melting at its best. Here . . . where furnaces of up to 5 tons capacity melt metal for centrifugal castings weighing up to 20 tons . . . Ajax Northrup induction equipment has simplified techniques, improved casting quality and permitted a cleaner, more efficient shop.

The Sandusky installation typifies a melting technology that has revolutionized foundry procedures . . . casting parts of accurate analysis faster and with less waste. Sandusky also represents extreme flexibility of induction melting. Two motor-generator sets permit complete freedom of choice when selecting melting facilities for a particular job.

These advantages of Ajax-Northrup induction melting equipment can be realized in your foundry . . . whether ferrous, non-ferrous, or both. Write Ajax Electrothermic Corp., Trenton 5, New Jersey, for additional details in Bulletin 27-B.

Associated Companies: Ajax Electric Company—Ajax Electric Furnace Co.—Ajax Engineering Corp.



AJAX NORTHRUP SINCE 1916

INDUCTION HEATING-MELTING

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new books

Industrial Vision . . Henry W. Hofstetter, 189 pp. Chilton Company, Chestnut and Fifty-Sixth Streets, Philadelphia 39, Pa. 1956. $10.

Intended primarily as a text for use in undergraduate optometry courses, designed to familiarize the student with the analysis of visual problems and the visual characteristics of occupational groups, this book should be useful as a working reference for ophthalmologists, opticians, and optometrists concerned with industrial vision problems; for public health and industrial physicians, industrial nurses, industrial and human engineering psychologists, safety and personnel directors, and illuminating engineers. Chapters include: Industrial Eye Hazards and Protection, Visual Testing in Industry, Vision and Industrial Efficiency, Industrial Compensation for Loss of Vision, Visual Tests for Driving Ability, and The Relation of Vision and Visual Testing to Driving Ability.

Air Pollution Handbook . . Paul L. Magill, Francis R. Holden, and Charles Ackley. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N.Y. 1956. $15.

In 15 sections, the book includes city planning and industrial plant location, chemistry and physics of contaminated atmospheres, effects of meteorology; effects on humans, farm animals, and vegitation, sampling procedures, analytical and experimental test methods, abatement equipment and processes, and a review of basic legal considerations. Written by a group of experts, it covers the theoretical, technical, and practical aspects and discusses causes, effects and controls of air pollution. Numerous references.

Condensed Chemical Dictionary (5th ed.) . . Arthur Rose and Edith Rose (editors) 1220 pp. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. 1956 $12.50.

Chemical and physical properties of chemicals and raw materials; information on containers, shipping regulations and safety instructions; and new uses of chemicals in nuclear energy, chemotherapy and other fields of current interest. Includes over 30,000 entries covering, among others, such subjects as engineering materials, lubricants, metals and alloys, minerals, paints and organic coatings, plastics, refractories, and trade names.

Elements of X-Ray Diffraction . . Cullity, Bernard Dennis, 514 pp. Addison-Wesley Publishing Co., Reading, Mass. 1956. $10.

To acquaint the reader who has no previous knowledge of the subject with

the theory of x-ray diffraction, the experimental methods involved, and the main applications. Because the author is a metallurgist, the majority of the applications are described in terms of metal and alloys. However, x-ray diffraction is stressed, rather than metallurgy.

Industrial Ventilation Manual (4th ed.) . . American Conference of Governmental Industrial Hygienists, P.O. Box 453, Lansing 2, Michigan. 1956. $4.

A compilation of practical data and information on the design, maintenance and testing of industrial exhaust systems. This manual, which was originally designed as an industrial exhaust system handbook at an engineering level has been used as a textbook for industrial hygiene in various colleges. Bibliography.

Symposium on Impact Testing . . American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1956, non-members $3.50, members $2.65.

Presented at the 58th Annual Meeting of ASTM, this symposium tries to fulfill the need for information on impact testing of a variety of materials by discussing impact and shock tests for parts, components, and complete structures. Impact tube and environmental conditions, particularly temperature are discussed. Graphs, charts, photographs, and bibliographies.

Scrap Yard Handbook . . Department of the Army, the Navy, and the Air Force. 127 pp. PB 121093, (available from) Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C. 1955. $2.50.

Designed to point out the most practical methods in the recovery and disposal of ferrous and non-ferrous scrap and waste materials at military activities, and to provide information and assistance as to the means and methods of accomplishing this vital task. Also list of other types of waste materials and suggestions for their use.

Applied Metallurgy for Engineers . . Malcolm S. Burton. 407 pp. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y. 1956. $7.50.

A text for survey courses in metallurgical technology for non-majors which seeks to develop the metallurgical principles involved in casting, metal working, welding, heat treatment, and powder metallurgy and to study these manufacturing processes from an engineering viewpoint, including the metallurgicals factors that control selection of suitable processes, and the influence of the processes on the final products. Emphasis is on the background of metallurgical science essential for proper utilization of metallurgical manufacturing methods. Recently developed processes such as shell molding, inert-gas-shielded metal arc welding, and vibrationless mid-air forging are considered.

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CIRCLE NO. 102, PAGE 7-8

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CIRCLE NO. 103, PAGE 7-8

committees in action

The Materials Used in Malleable Foundries Committee met in Chicago, September 17-18, with seven present. Most members brought to the meeting casting sections with gas defects. The committee classified the gas-caused defects as (1) mechanically entrained or entrapped gases, (2) evolution pin holes, and (3) reaction-caused pin holes. P. Humont's report on "Surface and Sub-surface Pin Holes" found no positive correlation between pin holes in malleable iron and hot molding sand but pin hole incidence was reduced by standardization and speeding of pouring rate. E. Zuppann listed the following factors for consideration in studying pin hole porosity: (1) metal temperature and gas content, (2) chemical analysis, (3) softening point of sand, (4) sea coal, (5) moisture, (6) clay substance, and (7) ramming. D. Dalton compared the effects of different clay-substances on pin holing. R. Brookes discussed effects of moisture. E. Zuppann detailed some statistical procedures for evaluating data and designing experiments for pin hole studies.

The Controlled Annealing Committee of the Malleable Division met in Chicago, October 5, with four present. The extensive committee report "Considerations of Factors Governing Selection of Modern Malleable Heat Treating Equipment" presented at the 1956 Castings Congress is being published as the February Bonus Section of MODERN CASTINGS. The committee decided to present a shop course session at the 1957 Congress. The course will cover annealing cycles with emphasis on first stage graphitization, cooling from first to second stage, second stage graphitization, effects of atmosphere on cycle, and suspended cycles. Questionnaires are being prepared for mailing to malleable foundries to serve as a guide in preparing shop courses.

The Malleable Division Research Committee met in Madison, Wisconsin, October 19, with 14 present. R. W. Heine presented a progress report on the AFS sponsored research project at the University of Wisconsin—"Effects of Melting Furnace Atmospheres and Melting Variables on Properties of Malleable Iron." The committee decided the project should be brought to completion in time for

presentation at the 1957 Castings Congress and the report sold in pamphlet form. The committee, after extensive discussion, selected as its next research project—"A Study of Increase in Section Size of Malleable Iron Castings to Produce Sound Castings Without Mottle or Primary Graphite and Without Impairing Annealability." Invitations to bid are being sent out.

The Safety Committee approved the chapter on fire prevention for the Safety Manual. This chapter covers the causes of foundry fires, insurance protection, cooperation with local authorities, types of portable fire extinguishers and their use, and employee participation.

The Core Test Committee met in Detroit, October 19, with 22 present. W. Peterson was elected the new chairman of the committee and C. Jelinek, vice chairman. A tentative testing procedure for CO_2 hardened cores was developed at the meeting. In brief, it was decided to use the standard AFS sand with 4 per cent by weight of silicate binder added during mulling. For a 24 in. muller a batch should weigh 5000 grams and be mulled 3 minutes. Completed mixtures should be stored in containers with tight fitting lids. Compression, hardness, and tensile strengths should be made. The cores should be rammed so as to duplicate actual foundry practice as closely as possible. The CO_2 should be passed through a drying substance and cores gassed at 5 psi for 45 seconds in a restricted fixture. Cores should be tested immediately after gassing and again after one hour aging in room atmosphere. Since this procedure is only tentative the committee welcomes any comments.

The Light Metals Executive Committee met in Des Plaines, Ill., October 24, with seven present. The Convention program was discussed and reports were made on the status of papers for the titanium and die casting sessions. After discussing other papers it was decided to hold three or four sessions, depending on the number of papers made available. The subject of the round table luncheon will be "Engineered Light Metal Castings" with the speaker to be announced later.

The Flowability Committee of the Sand Division met in Detroit, October 25, with eight present. With the goal of devising a simple test for measuring the flowability of foundry sands, the committee decided that

Continued on page 30

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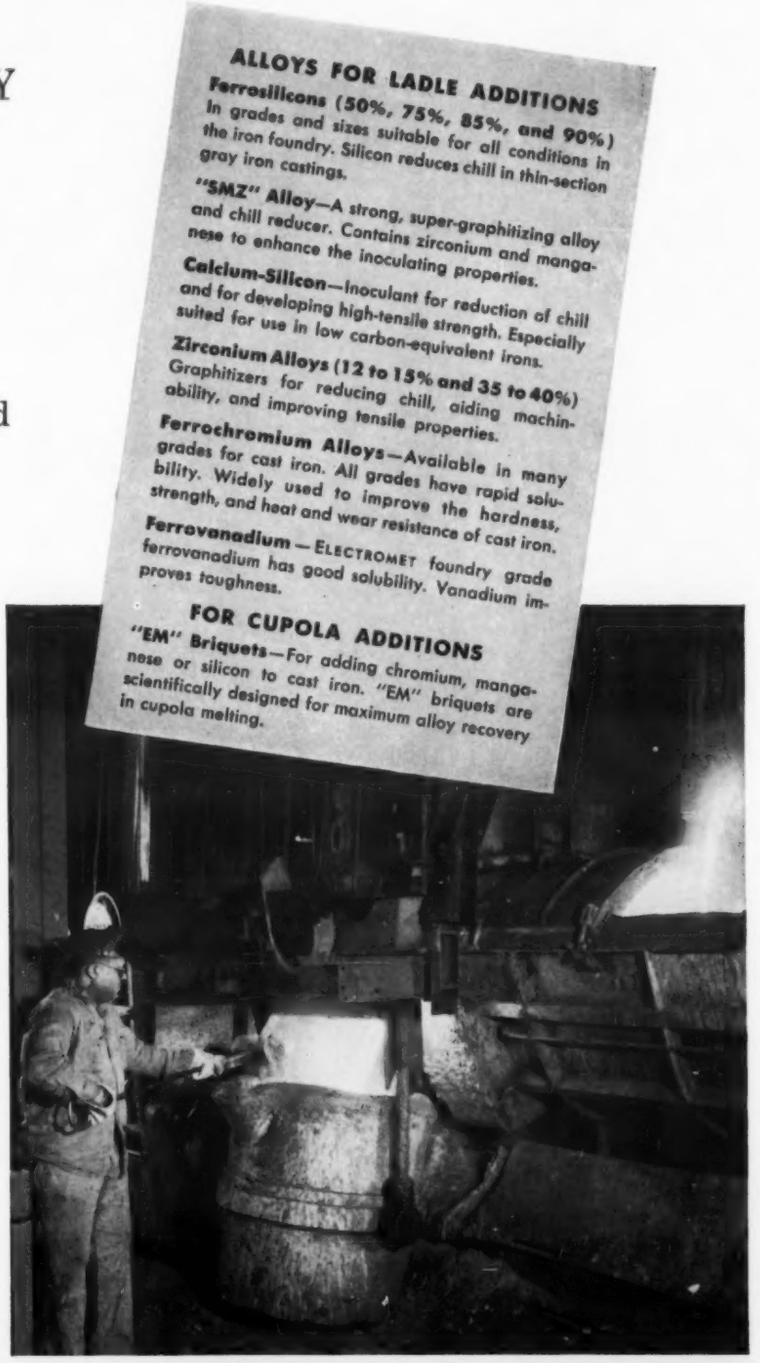
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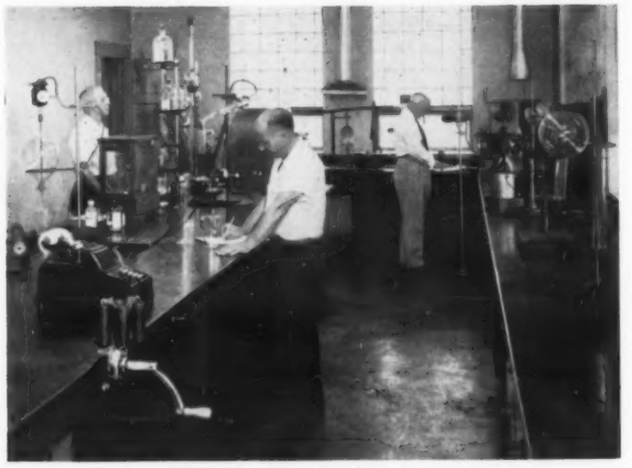

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Committees In Action

Continued from page 29

such a test must be operative at all levels of ramming and have a quantitative criterion for measurement. After full discussion of current flowability tests, the committee ran some tests using several of them. Interpretation of the results were inconclusive and the committee is continuing to seek an ultimate solution.

The Reorganization Committee of the Sand Division met in Detroit, October 25, with six present. After lengthy discussion it was decided that there was no need for a drastic reorganization of the Sand Division at present. The committee recommended to the Sand Division Executive Committee that certain practices be enacted to improve the activity of committees and to tie them more closely with the Executive Committee.

The Research Committee of the Light Metals Division met in Cleveland, October 26, with eight present. A Battelle Memorial Institute motion picture was shown demonstrating a technique for studying castings solidification with thermocouple measurements. The committee decided that Battelle should direct their experimentation to the use of the transparent mold-organic liquid technique. It was also recommended that the castings studied with the thermocouple technique be sectioned and an attempt be made to correlate grain size patterns with solidification characteristics.

The Basic Concepts Committee of the Sand Division met in Warren, Mich., October 26, with ten present. As the result of an election V. M. Rowell is now chairman and J. B. Caine is vice-chairman. J. B. Caine presented a discussion of Chapter XI – Particle Packing of Clay-Free Unbonded Sands – of G. Herden's book "Small Particle Statistics." From this discussion it would seem that dry unbonded foundry sands with a multiple screen analysis have a decreased density, void size, and permeability compared with sands occupying fewer screens. Plans were made for the agenda of the next meeting.

The Gray Iron Shop Course Committee met in E. Lansing, Mich., Nov. 9, with six present. Plans were made for two shop courses to be given at the 61st Castings Congress. The subjects selected were "Basic Structures as Steps to Quality Castings" and "Inoculation as a Step to Quality Castings."

the editor's field report

by J. H. Schaum

♦ **Painting Castings:** In traveling around the country I have become aware of an increasing trend toward the painting of ferrous castings before they are shipped from the foundry. When castings come out of the cleaning department their surface is usually in the optimum condition for painting as well as for corroding. Exposure to the elements during storage, inside or outside, soon results in surface corrosion. Further damage takes place during shipment to the purchaser. By the time the purchaser has the castings ready for painting they are covered with rust which must be removed by expensive hand grinding, brushing, and blasting. This tedious problem can be eliminated by spraying the castings with a primer-coat of paint when they come out of the foundry cleaning department. The purchaser receives castings free of corrosion and ready for final painting without the expense of a second cleaning. One Baltimore foundry is even painting aluminum castings. Industrial fan blades are dipped in gray lacquer after sand blasting. The purchaser finds this surface easy to clean after performing several operations on the blades in their plant prior to final shipping. Foundries would do well to point out these advantages to their castings buyers and paint before shipping.

♦ **Magnesium Designations Simplified:** The Dow Chemical Co. and the Aluminum Company of America have both agreed to drop their commercial designations for magnesium alloys and adopt the official ASTM designations. For example alloy AZ63 will no longer operate under the alias Dow Metal H or Mazlo AM265. Thanks for making life just a little simpler.

♦ **Radioactive Scrap:** Just about the time foundrymen have eliminated such ailments as silicosis and "zinc shakes" someone invents a new hazard. A foundry in the St. Louis area reports that they inadvertently acquired some lead contaminated with radioactive impurities. Fortunately it was discovered but not until added to a melt. The entire heat had to be pigged and buried. It looks like the Gieger counter will be the next new instrument needed for foundry control. Ironically one man's poison is another man's food. A prominent eastern smelter has contracted with the Atomic Energy Commission to de-contaminate a large quantity of radioactive scrap at Oak Ridge. The process involves melting the contaminated steel and aluminum scrap and preferentially fluxing out the radioactive elements.

♦ **AFS Central Michigan Chapter:** The chapter education committee is now correlating the cast metals programs in the industrial arts curriculum of ten high schools and one college located in their chapter territory. The committee activities include help with installing equipment, rehabilitation of education programs, technical assistance from local foundrymen, and student attendance at AFS meetings.

♦ **Acid Soluble Wax:** Techniques for producing intricate internal contours with water soluble wax cores are described in an article in this issue of MODERN CASTINGS. For some investment casters the wax dissolves too slowly in water. To meet this demand for speed a resourceful wax manufacturer has developed a wax which dissolves rapidly in a dilute acid.

♦ **Plastic Patterns and Core Boxes:** Many of your questions regarding the use of plastics for patterns and core boxes will be answered in the March Bonus Section devoted to this subject. In a recent visit to a foundry in the Philadelphia area I was impressed with their production of epoxy resin match plates. One style is made by pouring the resin into a plaster mold so that it keys into an aluminum plate. In another type the plate and pattern are both plastic. A resin filled with steel filings has been found most satisfactory. Starting with only one wooden pattern a multiple pattern matchplate can be accurately produced in a fraction of the time required for wood or metal and at phenomenal reduction in cost.

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Lebanon Steel Foundry is typical of scores of foundries, of all types and sizes, that are switching to Edco Dowmetal Bottom Boards because of their performance and *permanence.*

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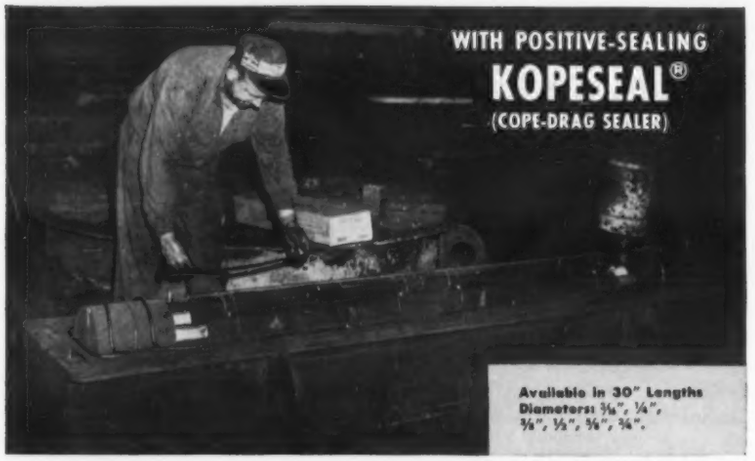

In a mold like the one shown here, 90% of the success of the casting depends on proper sealing. Because of its great length, heat distortion, with the mold lifting in the middle, is an ever-present possibility. To protect a costly casting, this unusual tubular section is being sealed along the full length of the parting line as well as at the end cores.

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CIRCLE NO. 142, PAGE 7-8

the SHAPe of things

safety, hygiene, air pollution

by HERBERT J. WEBER

Industrial Hygiene—What is it?

When people hear of industrial hygiene for the first time they associate it with a kind of vague thing that is somehow related to dental hygiene, personal cleanliness, or latrine inspection. Actually, hygiene is a system of rules designed for the preservation of health, and *industrial hygiene* is the science of preservation of the welfare of industrial workers and of prevention of occupational diseases.

How Industrial Hygiene Began

Many historical writings refer to the unattractive lot of the people who earned their livelihood by manual labor. In the early times, the drudgery was done by slaves. Then came the feudal times and the days when a trade was either handed down from father to son or was taught by a master craftsman to an apprentice.

At any rate, the majority of people did manual work and could never transcend the station of life in which they were born. Since the nobility were free from any sort of work, they devoted their time to the study of art, music, philsophy. Hence they received a liberal education—"liberal" from the Latin word "libero" meaning "free from." Hence by the very nature of things, there was no incentive to study the adverse effects of occupational environments or to do anything about correcting them.

In a democratic society, however, most everyone is required to work for a living and out of this very need arose a quite universal interest in the improvement of working conditions. Early beliefs that unhealthful conditions are a part of certain trades have now been disproved through the science of industrial hygiene.

Yet even today some plant operators believe that dust fumes and dirt cannot be eliminated or controlled. This is not entirely the fault of the operators; it may be that the technical people have failed to provide correct information on proper design, layout and ventilation. No one wants a dirty plant if a clean one can be had practically and economically.

In modern times, human labor is no longer a commodity that can be bought and scrapped like a piece of machinery. A human being has dignity and constitutes industry's greatest investment.

Because of these things the science of industrial hygiene came into being.

Industrial Diseases

The recognition of industrial diseases was slow and medicine was based more on superstition than on scientific fact. Little was known about the usual diseases, to say nothing of industrial diseases.

In the fourth century, B.C., Hippocrates first recognized the symptoms of lead poisoning in miners.

In the first century, A.D., Pliny the Elder described the goat bladders cinnabar miners used over their faces in order to avoid inhaling the poisonous mercurical dust of red cinnabar. They suspected this dust was harmful.

It was not until the fifteenth century that it was discovered that the fumes of some metals were dangerous to health. In the sixteenth century the effects of certain dusts on the lungs were recognized. The resultant disease was called asthma.

Paracelsus (1493-1541) described diseases of miners caused from digging and smelting zinc, lead, copper, etc. In 1700 Ramazzini published a fairly complete treatise on occupational diseases. However, the measures he advocated were therapeutic rather than preventive—a trend that continued until modern times when industrial hygiene was organized into a science dealing with prevention of industrial disease.

Today industrial hygiene is concerned with all factors affecting industrial health and welfare, such as heat, light, noise, radiation, vibration, dust, fumes, gases, air pollution, etc.

With the introduction of new materials in industry, the profession of industrial hygiene will be ready to appraise their effects on the environment of workmen. An outstanding example of this occurred when the *apparently* harmless element beryllium was introduced to industry.

The feudal days are over. Man is safer at work today than at home.

Berkeley Will be Site Of 1957 California Regional

■ Air pollution and general foundry practices will be the major topics under discussion at the California Regional Foundry Conference to be held March 15-16 at the Hotel Claremont, Berkeley, Calif. The conference is sponsored by the Southern California and Northern California Chapters of the American Foundrymen's Society.

Charles R. Marshall, Industrial & Foundry Supply Co., Oakland, Calif., is general chairman. Harold Hirsch, American Manganese Steel Div., American Brake Shoe Co., Oakland, is the technical session chairman.

Conference chairman Marshall, left, discusses program with Riki Lipe and Harold Hirsch, technical chairman, while Jay Snyder, chairman of public relations lines up the trio.

FRIDAY, MARCH 15

9:30 am . . . AIR POLLUTION, speaker, Benjamin Linsky, air pollution control officer, Bay Area Air Pollution Control District.

10:30 am . . . EDUCATION—F.E.F.—APPRENTICESHIP, speakers: E. Paul DeGarmo, University of California; Maurice C. Sandes, Division of Apprenticeship Standards, State of California, Clayton D. Russell, Phoenix Iron Works, Oakland, Calif.

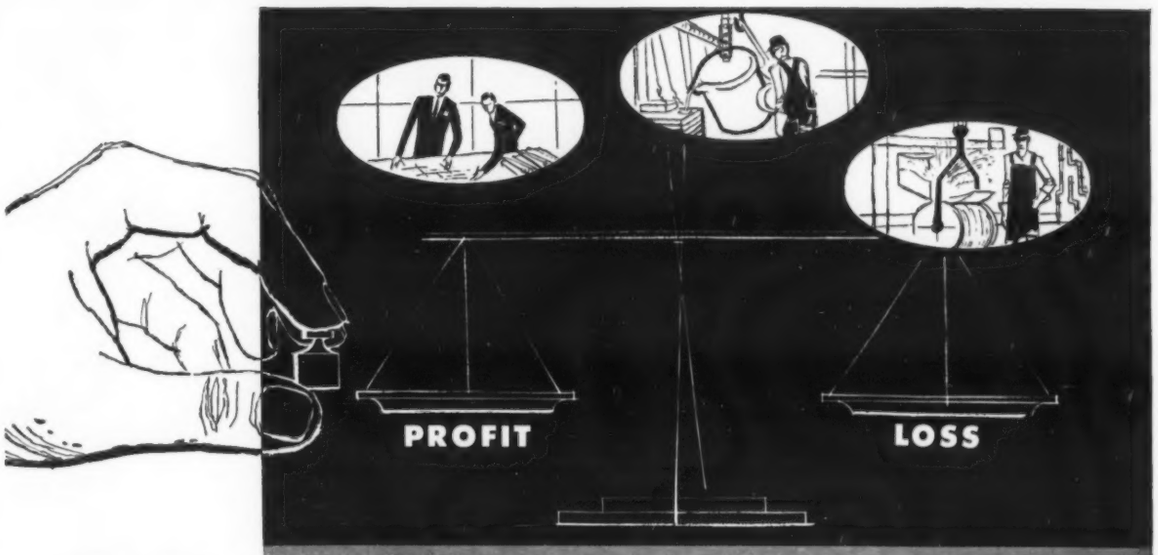
12:15 pm . . . MANAGEMENT LUNCHEON

1:30 pm . . . SECTIONAL MEETINGS
ALUMINUM, *"Modern Aluminum Alloys and Their Application in the Foundry,"* Walter Bonsack, Jobbins Co., Los Angeles.
CUPOLA PRACTICE, *"Coke and Its Relation to Cupola Operation,"* John W. Rendall, Great Lakes Carbon Corp., St. Louis, Mo.

3:00 pm . . . GENERAL FOUNDRY PRACTICE, *"Gating for Pressure Casting and Economical Molding Practice,"* Dominic Coccione, Washington Iron Works, Seattle, Wash.

4:30 pm . . . SAFETY, *"Knowing Not Enough,"* F. H. Kobely, Columbia-

Continued on page 34



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CIRCLE NO. 110, PAGE 7-8

Let's Talk

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In itself, a planer does not constitute a pattern shop . . . but as typical of the unusual equipment on our working team, it assures you of the facilities to make the finest patterns accurately and economically. And this is the very reason leading manufacturers have relied on City Pattern Foundry and Machine Company for almost forty years.

Setting the Pattern in Patterns

CITY PATTERN
FOUNDRY AND MACHINE CO.
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Continued from page 33

Geneva Steel Div., United States Steel Corp., San Francisco.

5:30 pm . . . FELLOWSHIP HOUR

7:00 pm . . . DINNER, Harold E. Henderson, chairman, Prof. Gilbert S. Schaller, University of Washington, speaker.

SATURDAY, MARCH 16

9:00 am . . . SECTIONAL MEETINGS

STEEL, *"What Occurs After Mold Is Made Until it is Poured, What Can Effect the Cleaning Cost?"* Herbert Chappie, National Supply Co., Torrance, Calif.

BRASS AND BRONZE, *"Scrap Procedure for Foundries,"* Martin Dietl, Burndy Engineering Co., Lynnwood, Calif.

10:30 am . . . SECTIONAL MEETINGS

VACUUM PROCESSES, *"Some Advantages and Limitations of Foundry Operation Conducted in High Vacuum,"* Charles d'A. Hunt, Temescal Metallurgical Corp., Richmond, Calif.

FOUNDRY RESINS, *"Applications of Foundry Resins,"* Lee Stark, Research and Development Dept., Barrett Div., Allied Chemical & Dye Corp., Edgewater, N. J.

12:00 . . . BUFFET LUNCHEON

1:30 pm . . . GENERAL FOUNDRY PRACTICE, *"Gating and Risering,"* Harold F. Bishop, Exomet Inc., Conneaut, Ohio.

3:00 pm . . . GENERAL FOUNDRY PRACTICE, *"Foundry Problems,"* Harry H. Kessler, Sorbo-Mat Process Engineers, St. Louis, Mo.

5:00 pm . . . FELLOWSHIP HOUR

Outline Radiation Manual

An outline was adopted for the American Foundrymen's Society Radiation Protection Manual at the November meeting of the AFS radiation protection committee. Assignments were made for compiling the various sections.

The manual will contain sections on hazards, maximum permissible exposures, selection and training of personnel, instrumentation, personnel monitoring and medical controls, shielding in general, isotope handling in laboratory, general procedures in radiography, use of isotopes as tracers, use of isotopes as sealed sources and emergency procedures.

Looking . . .

. . . for new production ideas? Circle numbers on Reader Service cards (page 7-8) to get more information on products and services described in Products & Processes and For the Asking.

CIRCLE NO. 83, PAGE 7-8

patent review

MELVIN NORD, *Dr. Eng. Sci., LL. B*
Consultant in Law and Engineering

Better Sand Molds

Perfect sand, that will not change in permeability or strength as it is rammed from soft to hard, may never be attained but various techniques for approaching such a sand have now been patented. Patent covers a process said to produce a mold of uniform permeability and uniform strength across a whole surface, so that a uniform casting can be produced. U. S. 2,756,476, issued July 31, 1956, to William H. Moore and assigned to Meehanite Metal Corp.

Glass Reinforces Cores

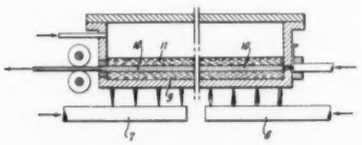
Glass tubes can be inserted in cores as a means of reinforcement. The coefficient of expansion and contraction of the glass is close to that of silica sand, and the cost is low. U. S. 2,752,652, issued July 3, 1956, to John F. Hurley and assigned to Central States Industrial Supply Co.

Mold Coat

Mold coating for permanent molds used in casting lead alloys insulates the mold and slows the cooling action producing a more uniform casting. U. S. 2,755,192, issued July 17, 1956, to D. G. Mahoney and assigned to General Motors Corp.

Casting in Liquid

Metal can be continuously cast by pouring it into a mold formed by the interface between two liquids that will



Liquids form mold metal.

not mix. In Fig. 1 the mold liquids (9) and (11) might be molten lead and molten barium chloride. Such a liquid mold could be used for casting iron, steel, or copper. One side of the mold is heated (6) and the other is cooled (7). U. S. 2,754,559, issued July 17, 1956, to H. A. Fromson.

Centrifugal Casting

Mold for centrifugal casting produces a casting without longitudinal grooves on outer surfaces. U. S. 2,752,651, issued July 3, 1956, to J. Seeba, P. Biefang, and A. Simonis, assigned to Eisenwarke Gelsenkirchen Aktiengesellscraft.

Assembling Investment Molds

Investment mold and core assembly method for precision casting operations allows for differential expansion and contraction of the assembly parts. Employed when a sand core is used with a wax pattern, the method involves the application of wax to the core prints. When the wax pattern is melted out, the wax on the core prints also melts leaving a space that allows for the difference in the expansion and contraction of the sand core and the plaster mold. U. S. 2,756,475, issued July 31, 1956, to D. K. Hanink and R. E. Claque and assigned to General Motors Corp.

Other Patents

Sprue reaming facilities for mold assembling installation. 2,752,646, Combustion Engineering Inc.

Foundry sand ramming machines. 2,752,647, Foundry Equipment Ltd.

Tap raising and lowering mechanism for a foundry ladle. 2,753,606, Industrial Equipment Co.

Aligning means for a flask. 2,753,607, A. B. Castagnola and E. J. Ritelli.

Non-reactive gypsum plaster mold. 2,753,608, Aluminum Company of America.

Alloying magnesium with cast iron. 2,754,201, International Nickel Co., Inc.

Mold assembling apparatus. 2,754,555, Spo, Inc.

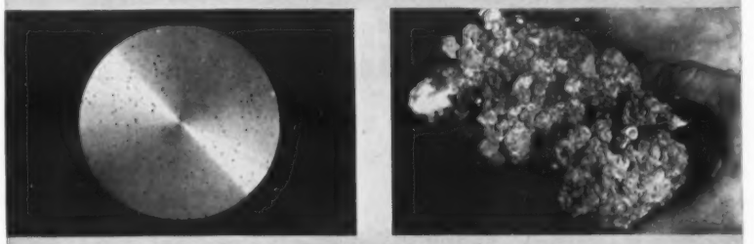
Die casting machine. 2,754,557, E. M. B. Co. Ltd.

Apparatus for handling mold flask sections. 2,755,124, Kelsey-Hayes Wheel Co.

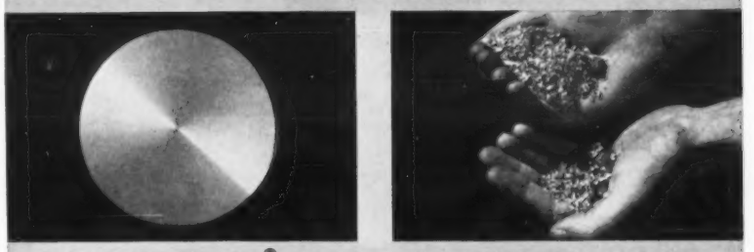
Reverberatory furnace for the manufacture of iron castings. 2,755,180, Carl George de Laval, Jr.

Process of introducing boron into ferrous metal. 2,755,181, L'Air Liquide.

Costly gassy and oxidized aluminum castings and metallic drosses like these



are eliminated



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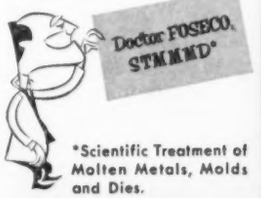
(1) Heat crucible and charge ingot and/or scrap.

(2) Dust on a layer of FOSECO COVERAL.

(3) Melt charge completely and plunge FOSECO DEGASER TABLETS.

(4) Dross-off with another small quantity of FOSECO COVERAL.



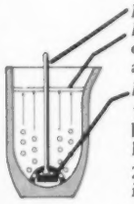
*Scientific Treatment of Molten Metals, Molds and Dies.

THE PROBLEM

Tough oxide film which forms on the surface of untreated molten aluminum.

Suspended particles of oxide (alumina), some of which are in contact with hydrogen gas. The oxide film prevents the hydrogen from rising to the surface.

THE SOLUTION



Plunger

Foseco Coveral Flux has absorbed the oxide into the dross which can be easily and cleanly skimmed.

Foseco Degaser decomposes to:

1. Liberate chlorine vapors which combine with and effectively remove the hydrogen.
2. Sweep all other impurities, including oxides, to the surface.
3. Break the surface tension of the metal by dissipating the oxide film, completely removing the last traces of gas and entrained oxide from the melt.

THE RESULT

A clean, gas and oxide-free aluminum melt, ready for pouring. Drosses are exceptionally low in metallics, fluidity is improved and strong, pressure-tight castings are produced.

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CIRCLE NO. 111, PAGE 7-8

ARE CASTINGS MEETING DETROIT DEMANDS?

M. F. Garwood /
Chief Engineer—Materials
Chrysler Corporation, Detroit

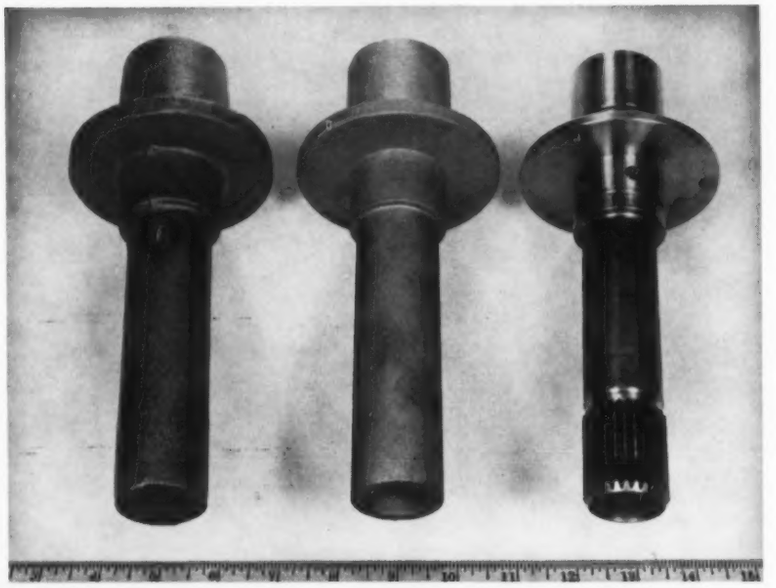
Today's castings may find no place in tomorrow's autos as Detroit calls for improvements in design, cost, quality, service

The future of castings, your future, in the automobile of tomorrow depends on many things—design, cost, quality, and service, to name the most important. Due to constant changes in materials and methods, there is no assurance that changes in design or other fundamental considerations such as cost, quality, or service will not drastically affect the current upward trend for your product.

You have heard some of the changes and have probably learned about some of the contemplated applications of cast metals for the models the auto-makers have just around the corner. You also know that we continually review new materials for old applications and old materials for new applications.

The application of cast metals in our automobiles is one of the materials engineer's most important problems. Before discussing the future for castings, let us examine the history of the automobile industry as a consumer of castings.

In 1936 the auto industry used 53 per cent of the malleable iron produced and 17.5 per cent of the year's gray iron production.



Pearlitic casting (center) has replaced steel forging (left) as raw material for machined transmission torque reaction shaft.

Pinion flange once forged, is now made of pearlitic iron.

Our demands from the non-ferrous metal producers were also large even then, for 23,500 tons of aluminum, representing 13.4 per cent of the total production, and 69,000 tons of zinc, representing 11 per cent of total production, went into domestic motor vehicles.

Now that we have fleetingly glimpsed our mutual dependence some twenty years ago, I would like to present the situation 19 years later, in 1955. As you know, it was a record year for us and a near record year for you as well. More than 9 million cars and trucks rolled off the assembly lines, and your industry produced nearly 19 million tons of ferrous and non-ferrous castings. The automobile industry used 56 per cent of the malleable iron produced, 25 per cent of the gray iron castings, 71 per cent of the permanent mold aluminum castings, and 43 per cent of the aluminum die castings. About 60 per cent of zinc die castings, 38 per cent of magnesium die castings, and a large part of the more than 100 thousand tons of ductile iron.

Comparing these values with those reported by the Automobile Manufacturer's Association in 1936, we find autos have taken an ever-increasing amount of castings production. Automobile industry usage of malleable iron rose 3 per cent, gray iron 8 per cent, and zinc jumped 48 per cent. The enormous percentile increases in aluminum, both permanent mold and die castings, cannot be easily calculated for the 1936 data were based on the use of the metal, and not castings. In addition to the four major cast materials considered in this comparison, we have added two more, magnesium and ductile iron, which surely merit recognition at this time and will be even more prominent in the future.

The data just presented are conclusive evidence that the auto and foundry industries are growing more and more important to each other. They are also significant proof that the foundry industry is alert and progressive.

You are in hotly-contended competition with wrought metal producers, with other foundry products, with plastics and a great many more non-metallic materials. To maintain your position, you must continue to keep ahead of your competitors. It may be we can help you by pointing out some areas which, from the consumers' standpoint, could stand improvement.

Possibly we can also help by telling a little of what we would like for the future. I believe it would be appropriate to give each of the major cast materials we use individual attention.

Gray Iron

Gray iron's wide use is probably due to the fact that it is the most inexpensive cast material we have. Also, its price history hallmarks it as a stable material insofar as cost is concerned. These two attributes are certainly in its favor. There is no scarcity of suppliers; in comparison with other materials the manufacture is fairly simple, requires no special equipment, and is well established and understood.

By juggling the chemistry a bit, using conventional ladle inoculants of silicon and alloys, or by employing the newer calcium carbide injection, we have a very useful ma-

terial which possesses a fairly wide range of physical properties. Unlike some other materials, it may be cast in green or dry sand, permanent mold, shells, etc., so that it might be said to be quite versatile. It possesses excellent castability, is easily machined, and heat treatable by a variety of processes.

With all these good qualities, and some well known limitations, we still experience considerable trouble with gray iron castings due to non-uniformity. The more or less homely, old familiar complaints of hard spots, porosity, burned-in sand, and variable hardness generally associated with inadequate quality control plague us. We certainly wish you would redouble your present efforts to introduce statistical control methods as rapidly as possible.

Permanent mold cast iron is an excellent material which has never been fully exploited. Possibly its major advantages are low cost, a high degree of uniformity, good machinability, and the fact that it is capable of very high production rates. The foundry process itself suggests it is ideal for automation, and the product lends itself to further automation because of its excellent uniformity. The main limitations of this material might be the casting size now possible and inherently mediocre wear resistance under certain engineering conditions. We would like to see this material exploited further. It would also be desirable if we could obtain larger permanent mold castings and some castings made with shell molded cores which we feel would allow casting to closer dimensions.

We have in mind permanent mold castings for transmission pressure plates, oil pump and distributor gears, reaction shafts, and transmission drums.

Malleable

In considering malleable iron, I believe its increased use has been largely due to the recent trend to replace many steel parts and some cast iron with pearlitic malleable iron. Therefore, I would like to confine my remarks to this specific material.

At Chrysler Corporation pearlitic malleable iron has replaced wrought steel in seven parts, and is presently being considered for replacement of steel in thirteen others. Malleable iron has been replaced by gray iron in three parts, and three other pearlitic malleable iron parts are presently under study for the same change. For the first time since I can remember, we are seriously contemplating the use of three steel castings to replace wrought steel now released for those parts.

The trend to use more and more pearlitic malleable iron in automobiles has been the result of two things. First of all, there has been a considerable amount of research and development work on new addition agents. The use of boron and bismuth, for example, permit the casting of larger sections.

Second, I believe that there has been a general awakening in our industry to the possibilities of pearlitic malleable iron. We are using it for, and trying it for, parts never before seriously considered, simply because we neglected its properties, did not visualize its potential, or did not understand until recently the stresses involved in components where this iron could be used to advantage.

As a material, malleable iron is comparable to gray iron in price stability and, if price were to be based on physical properties, it would be our lowest cost cast ferrous metal. There is no shortage of this product, yet we find only a limited number of foundries presently making high-grade pearlitic malleable castings.

Again, like gray iron, good foundry control is essential; but, unlike gray iron, melting errors cannot be rectified readily in the ladle. It has good machining characteristics; a wide range of physical properties; good wear, damping, and fatigue; may be selectively hardened; and its weldability is fair.

On the negative side we find big differences in machinability characteristics between identical parts furnished by different vendors. This can usually be traced to the surface condition of the castings which varys from a completely ferritic skin free from carbides to a dense pearlitic skin devoid of temper carbon nodules. To us, the surface condition of malleable castings is important since it affects both the machining and dynamic strength of the parts. We hope you realize this importance and attempt to eliminate the inconsistencies. Also, if you have not heard the complaint, we do have problems with casting dimensions, mostly caused by mismatches at the parting lines.

We anticipate the pearlitic malleable foundrymen will provide a better way to produce castings with more hardenability. By imparting more hardenability to this material, broader applications, and consequently larger sales, will be possible. One of the new applications we are thinking about is transmission gears where we have found hardenability to be a very real obstacle in our progress.

We also wish you would all explore the possibility of hot and cold coining as a means of minimizing machining operations. In one application we find that we may save as much as nine cents by using a coined pearlitic malleable part instead of a machined forging.

Some popular applications for pearlitic malleable iron promise to be cast crankshafts, output flanges for transmissions and rear axles, propeller shaft flanges, transmission and rear axle gears, wheel hubs, and possibly connecting rods.

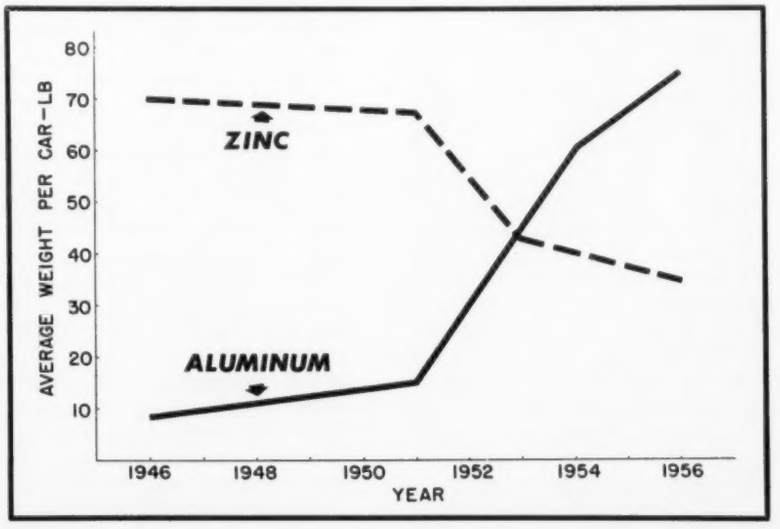
Ductile Iron

The fact that the automobile industry used 108 thousand tons of ductile iron in 1955 shows this material is gaining rapidly in popularity. I believe we should consider its present and potential use.

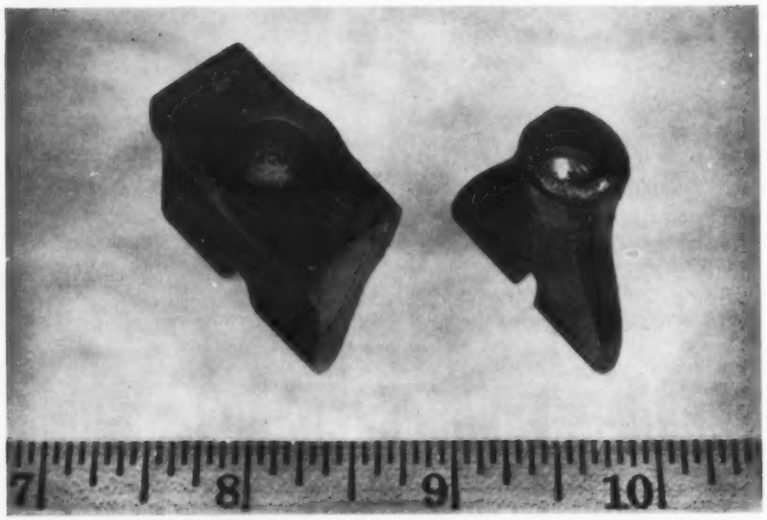
At today's prices, ductile iron cannot replace pearlitic malleable

Malleable transmission clutch hub replaces steel forging.

Permanent molded iron plate replaces aluminum die casting.



Base metal cost of zinc limits increase while aluminum useage zooms.



Hot coining is an area for malleable producers to explore. This hot coined pearlitic transmission band anchor replaces a steel forging.

iron in a great many applications, although it is successfully competing in a few. It can replace steel castings or wrought steel, and we think its potential is great. The calcium carbide treatment should also help ductile iron to become more competitive. It is far less sensitive to section size than pearlitic malleable iron, but otherwise has equivalent or better castability, machinability, etc. It also possesses similar engineering properties, although its modulus of elasticity is slightly lower and its weldability is better. It appears the expanded use of ductile iron will continue.

Light Metals

Castings have always offered the automotive industry a superb means of producing complex shapes at an acceptable cost, and certainly the light metal castings, both die and permanent mold, are outstanding examples of this ability. The volume availability of aluminum and magnesium must be included as an asset in any long-time materials consumption consideration. Their light weight is not only beneficial in reducing component weight, but also facilitates handling and transportation. Castings illustrated on the cover of this magazine are examples of aluminum castings formerly made of ferrous materials.

Light metals have the ability to be cast to very close dimensional tolerances, eliminate many machining operations, and, when machining is necessary, they perform very well indeed. Probably their eager acceptance by the automobile industry has been the ready adoption of these metals to our low cost, high production processes referred to earlier as automation.

Probably the most numerous, and certainly the most publicized changes in automotive castings have been the replacement of both wrought and cast ferrous materials by aluminum die castings. At this time, thirteen cast iron parts have been discontinued by Chrysler in favor of aluminum die castings as have three wrought steel parts, two pearlitic malleable iron castings, two ferritic malleable iron parts, two gray iron castings, one permanent mold iron casting, and several permanent mold aluminum parts.

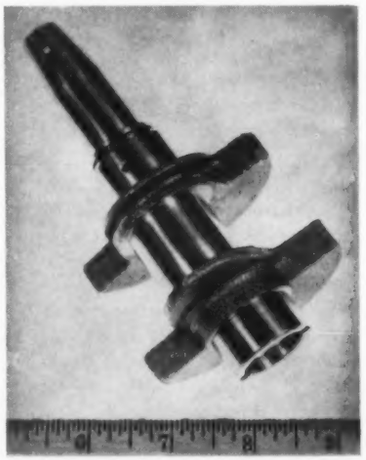
Permanent molded aluminum has also taken its toll of ferrous parts by replacing two wrought steel parts as well as several malleable iron and gray iron castings.

We believe the trend to use more and more light metals in our future cars will continue. Some specific applications presently being investigated are aluminum die and permanent mold castings for cylinder blocks and heads, brake housings, differential housings, oil and water pump housings, and decoration.

The acceptance of magnesium as a major automotive material has been slower than aluminum. It has, however, managed to replace one steel part on Chrysler cars and may, in the future, be used in applications such as clutch and converter housings, transmission extensions, wheels, and even fans.

We recognize and praise all the generous qualifications of light metals, still, like other cast products, they exhibit some deficiencies which continue to penalize their more rapid expansion. We urgently need your continued help in developing new aluminum alloys with improved machinability. Most aluminum alloys contain a high percentage of silicon, which causes poor tool life. Magnesium bearing aluminum alloys have excellent machinability, but foundries have been just a bit reluctant to make them because of their poor castability and consequent higher cost.

Variations in structure, hardness,



Compressor crank was forged, is now pearlitic casting.

and analysis within commercial limitations among different foundries in turn produce wide variations in machinability. Many times these require segregation of castings by vendor to satisfy production schedules. This causes additional work and unnecessary costs that we are unwilling to continue to absorb.

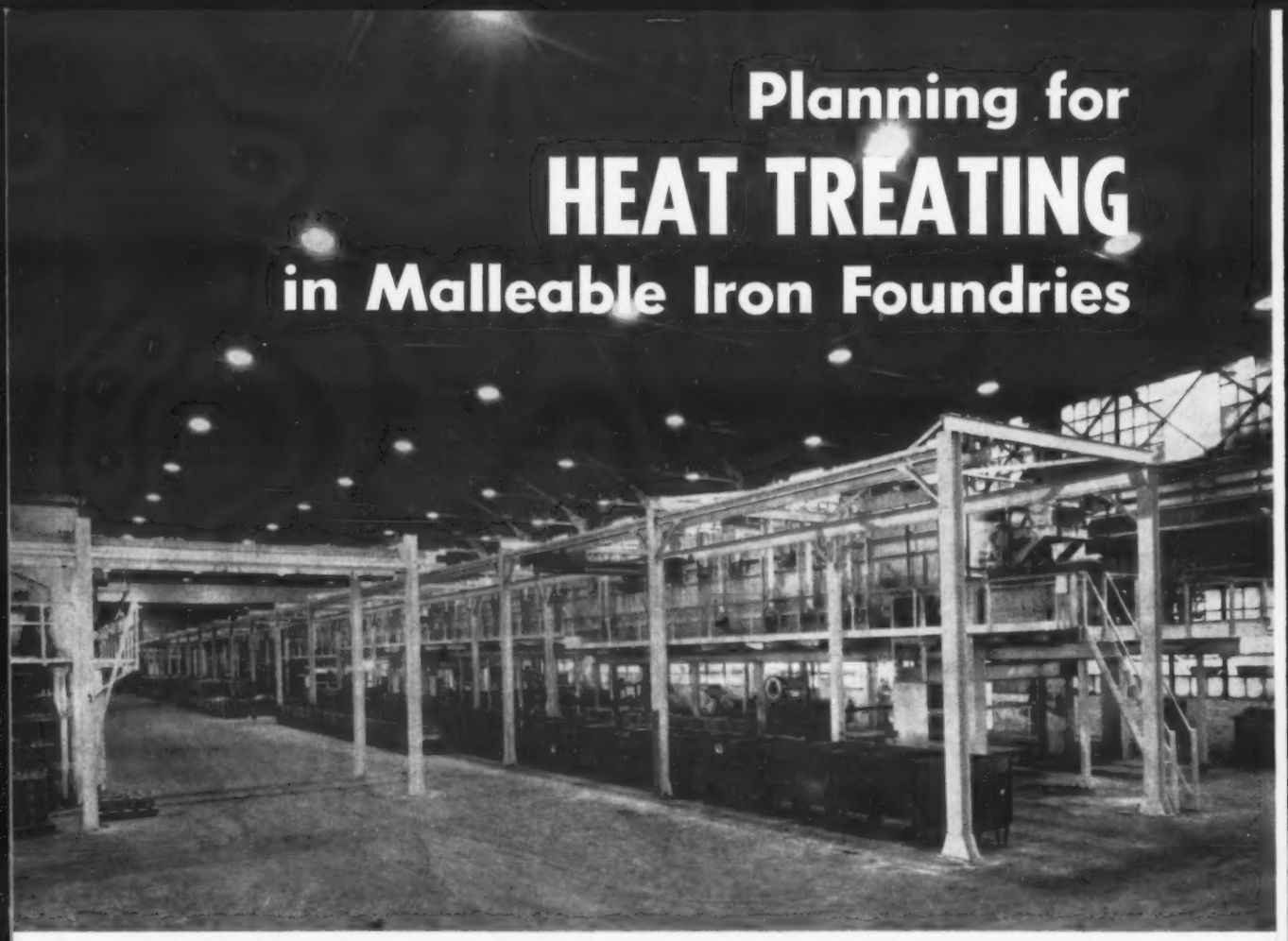
It has been our experience that the tolerances on die castings and permanent mold castings are not maintained as well as they should or could be. Excessive variations in permanent mold piston castings cause continual interruptions in automatic machining lines due to chucking difficulties or differences in casting weights.

More attention to soundness of die castings would provide additional applications in highly stressed parts and in parts subjected to substantial hydraulic pressures. Presently such applications, exemplified by transmission carriers and steering gear housings, require salvage procedures and far too much inspection to maintain production.

Both the aluminum and magnesium casting industries can give more attention to costs attributable to foundry practices. Either the base metal cost should be reduced or foundry efficiency improved. We feel this is mandatory if these metals are to continue to become more competitive with cast iron.

A die cast or permanent mold product for both aluminum and magnesium which can be economically surface finished by some process similar to anodizing to produce a suitable decorative part is also very desirable. This is a tremendous field for the light metal castings, and our stylists would be happy to have the opportunity to use them both on the inside and outside of our cars. At present, however, this field is limited to wrought aluminum or requires such high cost finishing media as chromium-nickel electroplating.

Up to this point very little has been said about a very important metal—zinc. You will remember that our industry used 60 per cent of the zinc die castings produced in 1955. This neglect to mention zinc is not an oversight. In my opinion, this family of metallic alloys holds a rather unique position in the automobile industry. The zinc foundry product is virtually confined to die castings and has undergone such a high degree of mechanical development in the last two decades that further development is limited unless base metal costs are lowered. The present use of this metal in die castings appears to be at, or very near, its peak, and I say this with full knowledge that this use depends largely on the desires of the stylist. Even so, I believe further increase in zinc applications is substantially retarded by today's base metal price, and use of the metal will decline if prices are not lowered.



Planning for HEAT TREATING in Malleable Iron Foundries

Economical and efficient heat treating calls for an understanding of the metallurgical problems and of modern equipment and techniques

Foundrymen producing malleable iron castings are harrassed by two sets of problems. First they must produce a sound casting of accurate shape with a white iron structure. Second, this brittle white metal must be converted by heat treatment into malleable iron, a tough ductile engineering material. This Bonus Section summarizes (1) the metallurgical practices which contribute to the production of white iron and (2) the selection of malleable heat treating furnaces, fuels, and auxiliary control equipment. This extensive summary was prepared by the AFS Controlled Annealing Committee (6-D) of the Malleable Division.

A MODERN CASTINGS

BONUS

This special report is the 20th in a monthly series presented by MODERN CASTINGS to analyze vital problems in the industry. A limited number of these reports have been reprinted and are available for 50 cents each.

The PROBLEM of MODERN HEAT TREATING

Authors: J. T. Bryce, L. E. Emery, F. W. Jacobs

Authors: L. R. Jenkins, G. B. Mannweiler, Wm. Zeunik

Modern malleable heat treating equipment may be defined as that equipment of proven design which inherently possesses the ability to heat treat a given analysis of iron in specified casting sizes at an economical cost and time, to predetermined and acceptable engineering standards of metallurgical and mechanical properties. In order to properly choose heat treating equipment it is important to fully understand the many factors which must be dealt with in making malleable iron.

Malleable iron has a chemical composition such that it solidifies as brittle white iron (all carbon in the form of cementite and pearlite). To attain the toughness and ductility that make this material a desirable engineering alloy, it must be heat treated in such a way that the brittle cementite is eliminated from the structure. By heating and holding the iron in the temperature range 1550 to 1700 F, austenite dissolves carbon from the cementite until saturated and remaining carbon is precipitated as temper carbon. This action eliminates the cementite and is called "first stage graphitization." The iron is next slowly cooled to a temperature below the critical temperature range of 1330 to 1370 F, causing the austenite to change to pearlite. By rapidly cooling the iron from this point the pearlitic structure is preserved and pearlitic malleable results.

If ferritic malleable iron is the desired end product the iron is held at a temperature just below the critical temperature for an extended period of time. During this time, the cementite in the pearlite transforms to ferrite by rejecting the carbon as more temper carbon. When this "second stage graphitization" has eliminated all the cementite the resulting ferritic malleable is allowed to cool to room temperature. This explanation of malleable iron heat treatment has been over-simplified for the purpose of introduction. The various factors which influence and determine the exact times and temperatures for heat treatments will now be discussed.

SELECTING PROPER FOUNDRY PRACTICES

1 - Chemical Analysis

Carbon, silicon, manganese, chromium, boron and phosphorous are the principal elements affecting heat treatment of malleable. Each will be discussed in order.

■ **Carbon:** Carbon is usually present in the range of 2.4 to 2.7 per cent. Many operators prefer to keep the carbon as high as possible (so long as section sizes of their castings are such that the carbon remains in the combined form) in the interest of increased annealability and greater fluidity.

■ **Silicon:** Of the major elements in white cast iron, silicon by far has the greatest influence on graphitizing rate both in first stage and second stage anneal. It generally ranges from 1.0 to 1.5 per cent. Increasing silicon content not only shortens annealing times but also makes the iron less sensitive during annealing to the effects of silicon and temperature variation. For instance, it has been shown that first stage holding time at 1700 F can be cut in half where silicon is increased from 1.00 to 1.40 per cent. In second stage anneal, cooling rates through the critical range can be increased and holding times below the range can be eliminated if silicon is increased sufficiently.

Variation of silicon content of ± 0.10 per cent in a 2.40 per cent carbon iron may call for variation of 40 per cent in first stage holding time at the 1.00 per cent silicon level, whereas the same percentage silicon variation at the 1.40 per cent silicon level would call for only a 30 per cent variation in holding time. Likewise, greater fluctuation in holding temperatures can be tolerated at higher levels.

Heat treating equipment must be considered in view of the maximum silicon content that can be tolerated in the base iron.

■ **Manganese:** Manganese by itself has little effect on graphitizing rates at normal manganese–sulphur ratios. Manganese will start to retard second stage graphitization when it exceeds by 0.15 per cent the normal content determined by the formula 2x%S + 0.15 per cent. Retardation increases with increasing manganese.

More important to be considered is the manganese/sulphur ratio. Times for first stage annealing are not sensitive to this ratio except for very low ratios below 1:2.

Times necessary for second stage anneal are sensitive to the manganese/sulphur ratio. This sensitivity increases with increased sulphur content. Increased manganese over that required to satisfy the sulphur lowers the ductility.

In the production of pearlitic malleable iron, Mn well in excess of that required to form MnS may be employed: (a) to permit through hardening of relatively heavy sections and/or large loads by air quenching and (b) to render the results of tempering more uniform. (This is important in selecting heat treating equipment, providing liquid quench facilities are not required.)

■ **Chromium:** The element chromium is considered a powerful retardant of graphitization. Normal annealing practice calls for keeping chromium content under 0.035 to 0.04 per cent. Increase of chromium contents by 0.01 per cent calls for increase of annealing time by 10 per cent, or increase of annealing temperature by 10 F, or increase of silicon by 0.05 per cent. Therefore steps should be taken to control residual chromium in purchased steel scrap. If high chromium content does occur in the base metal, ferro-boron in controlled amounts added to the iron will effectively counteract the retarding effect of chromium.

■ **Boron:** Boron is certainly one of the more interesting elements with respect to graphitization. Additions of ferro-boron to malleable iron to result in only 0.001 per cent to 0.002 per cent contained boron are beneficial for counteracting the retarding effect of chromium during the anneal. More recently the use of boron has been instituted to shorten annealing times because of its beneficial effect on graphite nucleation. For this effect boron contents up to 0.003 per cent have been used with success.

■ **Phosphorus:** Phosphorus acts as a carbide stabilizer in malleable iron. Each doubling of the phosphorus content increases first stage and second stage annealing times by one half and one third respectively. Phosphorus contents in malleable iron vary from 0.03 per cent to 0.16 per cent. High phosphorus within this range serves to increase ultimate strength, yield strength and hardness of malleable iron while elongation is decreased. Lowering the phosphorus decreases sensitivity to galvanizing embrittlement and improves notch ductility of malleable iron.

■ **Residual Element:** The most common residual elements which have an effect on the annealing process and resulting properties are molybdenum, copper, nickel, and titanium. Of these, molybdenum is a retarder of graphitization. Some times it is purposely added to malleable iron in quantities up to 0.50 per cent or higher, especially in conjunction with copper additions up to 1.00 per cent. Nickel acts as a graphitizer as does copper, and small concentrations of either element in the iron are of little consequence. Titanium in amounts over 0.04 per cent has been found to adversely affect physical properties. The element itself favors graphitization. Titanium enters the iron through pig irons and refractories, the amount dependent on degrees of oxidation.

2 - Melting Practice

■ The use of modern heat treating equipment requires that melting practice be held to exacting tolerances in order to gain full advantage of the savings in cycle time. Loose analysis and melting control will easily disrupt production scheduling through the modern heat treating department with possibilities of letting under-annealed castings reach the finishing department. Companies considering the purchase of modern heat treating equipment must also consider carefully whether their melting facilities are capable of close control. This involves the control of several melting variables which are briefly enumerated as follows:

■ **Base Charge:** The first consideration in duplex melting of iron should be the graphitic content of the charge. High graphite content promotes mottling which must be counteracted by running a lower carbon and/or silicon in the metal. Such a change in composition lengthens the annealing time.

Steel scrap must be controlled for harmful residual elements such as chromium which would retard annealing. Rusty scrap should be avoided as iron high in oxygen content does not anneal readily.

Pig iron should be controlled for titanium, as contents too high produce an iron with lower physical properties dependent on oxidation rate. Pig irons with kish entrapment are prone to produce mottled iron.

A big single item in metal control in duplexing is the type of coke used. The coke must be of uniform size and characteristics to prevent excessive carbon and sulfur pickup. Improper coke will lead to considerable variations in bed height throughout the heat with possibilities of producing over oxidized iron which is more difficult to anneal.

■ **Oxidation:** Over-oxidation in the cupola or air furnace accompanied by a high silicon loss is detrimental to good foundry practices both in respect to pouring, solidification rate, and annealing. Control of oxidation in the cupola depends upon proper coke, balanced combustion, correct charging, size and type of charge material, the flow rate of material through the cupola, blast temperature, and whether the air for combustion is dehumidified by means of lithium chloride treatment or by refrigeration methods.

Furnace atmospheres in batch melting and duplex melting have been shown to affect the annealability of the iron. The effects of free oxygen in the combustion gases are detrimental. First it can cause excessive loss of silicon, manganese and carbon. This alteration of base composition reflects itself directly in the properties of the iron and its annealability. Secondly, where analysis is not a factor, free oxygen in furnace atmosphere increases resistance to mottling and to first and second stage graphitization.

Irons melted under high nitrogen content (e.g., 79 per cent by volume) show resistance to mottling and resistance to first and second stage graphitization.

Atmospheres high in CO content produce an iron prone to mottle and most readily annealed.

Normal melting atmospheres are considered to be in the range of 12-14 per cent CO, 12-14 per cent CO_2 and approximately 75 per cent N_2.

Water vapor in the melting furnace atmosphere creates resistance to mottle, tends to create large flake type graphite and low nodule count in anneal, increases decarburization rate, and lowers physical properties. It does not appreciably effect first stage graphitization time, but adversely affects second stage cooling rate.

Melting atmospheres seem to have their most potent effect during the melt down stage.

■ **Hydrogen:** Hydrogen may be introduced to the metal by way of the cupola blast, furnace atmospheres containing high water vapor content, and high hydrogen content in the fuel.

The effects of hydrogen on annealability and physical properties of the iron have been stated in a preceding paragraph. Removal of hydrogen from the iron is accomplished by humidity control of the cupola blast and by carefully controlled reaction rates of FeO, CO, and CO_2 in the air furnace metal. The removal of CO and CO_2 gases from the metal facilitates hydrogen removal.

■ **Slag Control:** Cupola slag color changes during operation are a good criteria of melting conditions with respect to oxidation losses and FeO content of the metal. Light slags are beneficial to graphitization while dark slags high in FeO are detrimental.

It is customary in batch melting and in pulverized coal duplex melting to clean off the bath as soon as possible and maintain a clean bath throughout the heat. Thus the slag-metal reaction is held to a minimum. However, in oil fired air furnace melting, it is necessary to carry slag on the bath to prevent excess carbon reduction.

In electric furnace practice, light-colored slags have resulted in 100 per cent good castings out of the anneal. This percentage diminishes to the point where black slags high in FeO required 100 per cent recycling because graphitizing rate is retarded. With oil fired equipment furnace slags should be maintained below 10-12 per cent FeO for best results.

It has also been demonstrated that slags must be treated with iron ore immediately prior to the drain period of the furnace. By maintaining at least a 6 per cent FeO in the slag it has been found that mechanical properties of the test bars from the last 100 pounds of metal tapped out at the end of the heat have been at the same high level as those cast during the entire day. Without addition of iron ore to maintain FeO in the slag, test properties have fallen off considerably.

■ **Deoxidation:** The practice of deoxidation can be carried out in the cupola and air furnace by use of silicon carbide and in the ladle by addition of aluminum. Deoxidation practice has been revealed as a possible method of controlling the nodule count and size and the time required to complete first stage graphitization of white iron. Suitable deoxidation with aluminum or silicon carbide results in smaller graphite particles and less time for first stage graphitization.

■ **Pouring Temperature:** Pouring temperature is dependent on several factors: (1) the degree of superheat in the air furnace necessary to maintain analysis and proper reaction rates; (2) the temperature required at the mold to prevent misruns; (3) the rate at which the iron loses heat during transfer from the furnace to the mold and the rate at which the iron sets up in the mold. The degree of superheat required alters the mottling tendency of a given iron. Increasing superheat decreases mottling tendency. The cooler an iron is poured the faster it will solidify with resultant smaller grain size. The smaller the grain size, the faster will be the graphitization rate and the stronger the annealed iron.

3 - Casting Size and Shape

■ Since the molten metal destined to be converted into malleable iron is a section-sensitive material it is important to consider the size and shape of the castings to be made. The geometry of the castings will not only influence the chemistry of the iron but will play an important role in the selection of proper heat treating equipment.

With all other factors held constant, it is known that smaller sectioned castings cool faster in the mold and produce a finer grain structure than do heavy sectioned castings. Finer grained castings anneal more readily than do large or coarse grained castings. Furthermore it has been shown that time necessary to complete first stage graphitization is a function of section size, e.g., a 1-1/2-in. section thickness takes about twice as much time at 1700 F than does a 1/2-in. section.

The rate of heating to the upper critical effects the first stage holding time, the faster the heating rate the more time required at holding temperature.

From these observations it becomes apparent that the volume and surface area of the casting effect annealing time. The ratio of the volume of the casting to the area of the casting, $(V)^2/(A)$, is proportional to the cooling in the mold and the heating rate in the heat treating furnace.

The section size and volume also govern to some extent the type iron that can be poured without formation of the undesirable mottled grain structure. Producers of light section work can pour irons with higher silicon contents beneficial to shorter heat treating times. Conversely producers of heavy sectioned work must produce irons with lower silicons or carbons requiring longer heat treating times.

Overall dimension of castings as well as weight must be considered in determining the size and capacity of heat treating and auxiliary equipment.

Finally, casting design must be considered. Some castings of intricate design are more susceptible to cracking upon being subjected to high rates of heating and cooling.

Thus the size and shape of the castings being produced govern the type and size of heat treating equipment, length of heating cycle, and results that can be expected.

4 - Atmosphere

■ The atmosphere surrounding a casting during the heat treating process has a significant effect on the rate of graphitization. Hydrogen is a strong retarder of malleabilization. Carbon monoxide is also a retarder to a lesser extent. Water vapor reacts with carbon in the iron to form carbon monoxide and hydrogen. This is kept to a minimum by purging with a dry gas. It also reacts with carbon monoxide to form hydrogen and carbon dioxide. Carbon dioxide extracts carbon from the iron. It is important that the quantities of oxygen, hydrogen, water vapor, carbon dioxide and carbon monoxide in the furnace chamber be held to a practical minimum.

Malleable and pearlitic malleable iron producers strive to make a product of uniform hardness and microstructure. The desired microstructure shows a uniform distribution of temper carbon nodules throughout a matrix of ferrite in the case of standard malleable and a matrix of finely dispersed lamellar or spheroidal cementite in ferrite in the case of pearlitic malleable iron. The microstructure at the surface should be the same as in the core.

The loss of carbon from malleable or pearlitic malleable iron castings during heat treatment produces a microstructure at the surface which has fewer temper carbon nodules than the core. In many instances this depletion of nodules or complete absence of nodules may extend to a considerable distance below the surface. This condition decreases machinability and tends to produce a poor machined surface finish.

A considerable pearlitic rim is often associated with a nodule depleted surface. This pearlite is a coarse lamellar type which is abrasive to the machine tools. The nodule depleted skin also raises the nil-ductility transformation tem-

perature. Tensile test bars with this nodule depleted skin surface show higher ultimate tensile strengths and greater elongations than those of the same analysis which are heat treated in a neutral atmosphere and do not have this condition at the skin. The yield strength in either case remains about the same.

In the case of pearlitic malleable irons, this zone of nodule depletion may contain a high combined carbon content which results in a differential hardness between the surface and core of a casting. It can promote a cracking tendency during surface hardening.

Some batch furnaces are sealed and the castings inside decarburize slightly until the atmosphere comes to equilibrium when further loss of carbon virtually ceases. Such atmospheres approach 60-70 per cent carbon monoxide in the first stage and decrease to about 15 per cent in the second stage.

It is possible to generate a gas of the following composition from controlled combustion of natural gas. Other gaseous fuels such as propane, butane, coke oven gas, or mixed gas, may be used:

Nitrogen	96-99.5%
Carbon monoxide	< 1%
Hydrogen	< 1%
CO_2	<.2%
Dew point	—40F

This is accomplished by burning natural gas just short of completion to insure the absence of oxygen. The combusted gas is then passed through an absorbing tower which removes all the contained carbon dioxide. Then it is cooled in a refrigerator to lower the moisture content after which it passes through a drying tower to further remove contained water vapor to a low practical limit. This neutral gas is bled into the furnace chamber under a slight pressure, allowing leakages of the furnace to perform a purging operation. This gas is non-explosive, non-combustible, and can be introduced into a furnace at any temperature.

Some continuous furnaces are operated with a small quantity of air introduced to maintain an atmosphere of 16 per cent carbon monoxide, 8 per cent carbon dioxide, and less than 10 per cent hydrogen. The dew point is about 50-80 F. This atmosphere is combustible, very toxic, and presents an explosion hazard when the vestibule contains oxygen and the inner door of the furnace is opened to make a push.

It should be borne in mind that a neutral gas is a diluant and not a reactor. Therefore, the furnace atmosphere is controlled by diluting and purging instead of combining with any oxygen, hydrogen, or carbon dioxide present as in the case of a generated combustible gas.

Some batch furnaces are purged with a prepared combustible gas containing 10 per cent carbon monoxide, 5 per cent carbon dioxide and 6 per cent hydrogen, with a dew point of that approximating cooling water temperature. This gas is produced by controlled combustion of a gaseous fuel and water spray-cooling. It prevents scaling but allows some carbon loss from the surface of the castings.

A gas containing an excess of 7 to 8 per cent combustibles cannot be safely introduced into a furnace chamber below a temperature of at least 1400 F. A considerable amount of decarburization can be done during the time a casting is heated from room temperature up to the level at which a protective atmosphere can be introduced to combine with any oxidizing agents present in the furnace chamber. A neutral gas can reduce the quantity of these oxidizing agents to a minimum by dilution while the furnace chamber is still relatively cool.

5 - Casting Surface

■ The condition of the surface of the casting in relation to the annealing process must be considered under two categories. First, the mold metal reaction at the surface must be held to a minimum for maximum metal properties. Second, the cleaning of sand from hard iron castings is advantageous in keeping maintenance costs of the heat treating equipment to a minimum.

Considering the first category, any excess reaction of the molding sand with the solidifying metal in the mold is detrimental to producing a sound surface free from decarburization and pearlitic rim upon annealing. Also, sand and molding methods which produce swelled castings are detrimental to annealing practice. The large open dendritic grains in the swelled area of a casting are difficult to anneal and often, under oxidizing atmospheres in anneal, columnar cementite is retained near the surface of the casting. This creates a weak surface and promotes checking of the surface and failure of the casting at stresses below that for which the casting was designed.

The second category relates to excess sand clinging to the surface of the casting to be annealed. This sand upon heating will spall off in the furnace causing extra cleaning of handling equipment and oven chambers besides creating excessive wear on moving parts. Needless to say, sand clinging to the castings decreases the pay load by one to two per cent because of this added weight. Sand also impairs quenching efficiency and adds the expense of removing the spalled sand from the quench tank. Finally, the sand remaining after heat treatment is harder to clean off.

FACTORS AFFECTING ANNEALING OF MALLEABLE IRON

	Time For 1st Stage Annealing	Time For 2nd Stage Annealing	Other Effects
Chemical Analysis			
Increasing:			
Carbon	Decreases	Decreases	Increases Fluidity
Silicon	Decreases	Decreases	Graphitizes
Manganese		Retards	Air hardens easier
Chromium	Increases	Increases	Retards Graphitization
Boron	Decreases	Decreases	Counteracts Chromium & Graphitizes
Phosphorous	Increases	Increases	Carbide Stabilizer
Moly	Increases	Increases	Retards Graphitization
Nickel	Decreases	Decreases	Graphitizes
Copper	Decreases	Decreases	Graphitizes
Titanium	Decreases	Decreases	Graphitizes
Raw Materials Containing:			
Graphite or Kish			Increase Mottling
Oxygen	Increases	Increases	
Melting Atmospheres Containing:			
Oxygen	Increases	Increases	Decrease Mottling
Nitrogen	Increases	Increases	Decrease Mottling
CO	Decreases	Decreases	Increase Mottling
Water Vapor			Decrease Mottling
Deoxidation of Melt	Decreases		
Increasing Superheat of Melt			Decreases Mottling
Smaller Grain Size	Decreases	Decreases	
Increasing Casting Section Size	Increases	Increases	Increases Mottling
Annealing Atmosphere Containing:			
Hydrogen	Increases	Increases	
CO	Increases	Increases	
Water Vapor	Increases	Increases	
CO_2			Decarburizes Surface
O_2			Decarburizes Surface

Extra!

Extra news on new equipment developments in heat treating! The editors of MODERN CASTINGS have gathered extra news so that the reader of this Bonus Section may have a complete survey of the field. The new equipment news is in "products and processes" columns which start on page 6. New literature information is in "for the asking" columns which start on page 74. Look for the word "EXTRA!"

SELECTING PROPER HEAT TREATING EQUIPMENT

Consideration is now given to the types of furnaces available and their operating characteristics. Essentially there are two basic types; batch and continuous. Their relative merits will be compared in the following section.

▪ **Batch Type Furnaces:** Batch furnaces are known for their extreme flexibility of operation. They can readily handle wide variations in casting section size and weight, production schedule, heating and cooling rates. In the larger sizes, the labor (man-hours per ton) required to load and unload batch furnaces is no greater than for continuous furnaces. This cost is very largely dependent upon the type of casting being handled. Small castings requiring numerous small containers, of course, require more handling and produce low net furnace yields. Extremely large castings, as another extreme, require batch treatment.

Batch furnaces may be of the elevated type in which the entire load is raised on a refractory bed up into a heated, rectangular, gas-tight chamber. Another type is the cover type adapted from sheet steel mill practice which requires a heavy Gantry crane for transferring the heating cover from one annealing base to another. In neither case is an inner cover necessary. A third type is the car-bottom furnace. This has two variations, the conventional one-entrance design and a double entrance design having two charge cars hooked together moving together, discharging an annealed load as a hard iron loaded car is pushed into the heating chamber. Neither variation of the third type is recommended as the problems of tight door sealing and non-uniformity of heating at the open ends has never been successfully solved.

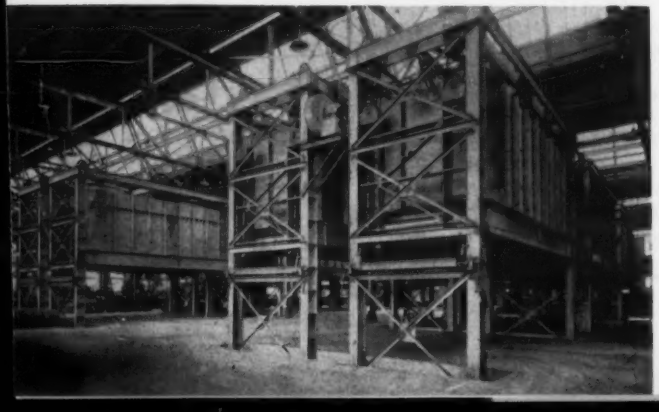
By their very nature, batch furnaces operate slower cycles than continuous furnaces. Heating is started on a cold load in a furnace at about 1200-1300 F in contrast to the full operating temperature of the continuous type. After heating until the outside of the load has reached hold temperature, a lag ensues until the coldest part of the charge reaches first stage temperature. This lag may be from 4 to 13 hours. On cooling, a similar lag further increases the total cycle.

The frequency and degree of temperature change in the batch furnace make maintenance costs somewhat higher per ton on batch furnaces. This is due to shorter life of alloy tubes, grids (for holding work on piers), containers and brickwork. Good alloy selection and good housekeeping in loading and unloading profoundly affect this cost. Lost time for maintenance is less for major repair of a batch furnace than for a continuous. Whereas a batch furnace can cool down in 2 days to room temperature, it takes about 5 days to cool down a continuous, 2 days of which labor is required to operate the pushing cycle. Likewise, on heating, a batch furnace may be charged 4 to 6 hours after start of heating, while it takes about 3 days of heating to bring a continuous furnace to temperature prior to charging.

Comparison of these two types for first stage treatment of pearlitic malleable differs somewhat from consideration of ferritic requirements. After completion of the first stage of anneal, pearlitic practice calls for a temperature drop in the furnace from hold temperature to 1525-1650 F followed later by a rapid air quench. Importance of uniformity of cooling temperature and cooling rate from piece to piece and load to load cannot be overemphasized. This applies particularly to work to be subsequently tempered only. The effect of non-uniformity at this point carries over into the draw treatment. It also affects control of work to be oil quenched and drawn as hardness specifications ranges are narrower for oil quenched work than for air quenched work.

Efforts to utilize batch furnaces with loads as light as 5 tons for first stage treatment have run squarely into the problem of obtaining uniformity of hardness throughout the load on cooling. At this point it is well to consider the tolerance in hardness permitted in the final product. If narrow hardness (e.g., ±0.1 Brinell hardness diameter), and mechanical property limits are to be met, continuous type furnaces are recommended.

High and low temperature electric batch annealing furnaces are paired for two-stage annealing process.



Transfer of castings from high to low temperature paired furnaces provides intermediate air quench.

As the acceptable range approaches ±2.5 Brinell hardness diameter, the batch furnace finds more application. Oil quenching of batch loads presents distinct fire hazards. Aqueous solution timed-quenching removes this danger but increases the tendency toward hardening cracks.

When flexibility of operation (small runs, wide variety of casting sizes, and hardness specifications) is of paramount consideration, the batch furnace is to be preferred.

▪ **Continuous Type Furnaces:** Basic to the design of any continuous ferritic annealing furnace is the exact determination of the minimum time-temperature treatment which will successfully anneal the heaviest section of the iron being considered. This must be clearly specified before a continuous furnace can be designed to an exact capacity. These data also determine the rate or cycle for estimating batch furnace capacity. For reasons previously discussed this information should not be calculated but be derived by actual experimental data. The furnace designer may calculate heating time and fast cool time, but depends on the founder for high temperature hold time and slow cooling time and rate.

The continuous furnace type is characterized by extreme uniformity of quality from tray load to tray load, day to day, and week to week. The overall cycle time for a given section size is usually less in a continuous furnace than in a batch furnace of less than half the weekly capacity. This results in a shallower decarburized rim condition in the casting.

Continuous furnaces may be of the sealed vestibule or elevated, non-vestibule type. The sealed vestibule type is usually a floor furnace with tight vestibules at each end for prevention of main chamber atmosphere contamination as trays are admitted or removed. This type gives excellent control of the atmosphere as the operator controls all elements affecting his atmosphere analysis. Overhead continuous furnaces may be either with or without vestibules. If with vestibules, the structure is raised to obtain floor space below the furnace for operations. If without vestibules, the furnace atmosphere is exposed to the air contamination twice per pushing cycle, once as the row of trays is admitted, and again as one is discharged.

The extent of the effect of this oxidation reaction depends on the duration of the exposures and the type of atmosphere being used. A choice between the vestibule and elevated non-vestibule depends on installed cost of either type complete with mechanized equipment to handle the trays in and out of the furnace and from discharge to charge end; the value one places on floor space gained by elevation; whether or not the building in which the furnace is to be placed has a high enough ceiling; and the type of atmosphere generator equipment being considered.

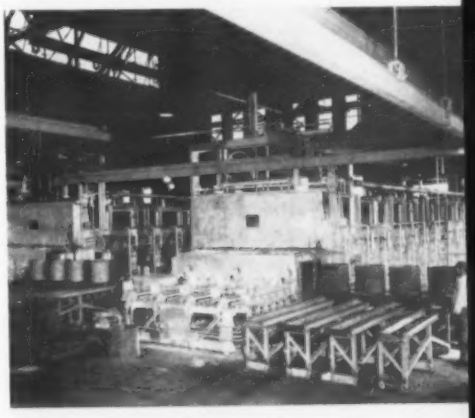
Since the continuous furnace actually operates by a short (one tray length), intermittent movement of uniformly loaded trays through the furnace on a set cycle, temperature conditions and atmosphere analysis assume a relatively set pattern. Once the pattern and allowable variations have been determined, careful and constant watch and study of these conditions are required in order to keep the process within the bounds of control. It is axiomatic that, in control, a continuous furnace pours out well annealed castings at a uniformly rapid rate.

Out of control, the rate of discharge does not diminish, and the pile of castings to be re-annealed accumulates at the same rate. Close attention to technical control is then a necessity with a continuous furnace. Careful study of the details, on the other hand, usually permits operation much closer to the minimum theoretical heating cycle than is possible in a batch furnace. Efficiency is gained at the expense of operating latitude.

Since atmosphere annealing has replaced pack annealing, there is no medium available for support of the castings during controlled atmosphere heat treatment. Small, thin-wall castings therefore may only be packed in small containers to avoid distortion by weight of loaded castings. As the size of casting increases, the ability to support greater weight increases and the size of the container may be increased. Since most high production automotive castings are die straightened after annealing, distortion becomes a serious consideration only if straightening equipment is not available. Small castings are better adapted to the continuous furnace unless small containers (at a loss of efficiency) are used to hold the small castings in the batch furnace.

A continuous furnace is designed to a specific requirement or metal analysis. The balance of duration of high temperature hold to slow cooling time must be known while the furnace is being designed. Once

Batch type furnace is a gas-fired radiant tube ferritic anneal unit.



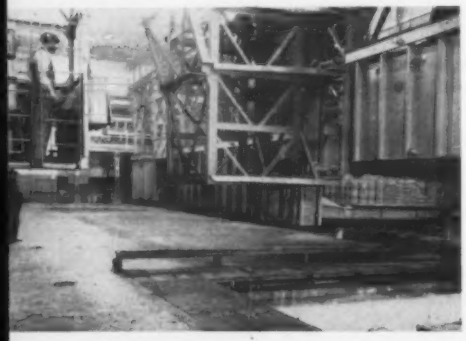
Continuous gas-fired radiant tube units are paired four rows wide.

Loading end of continuous electric ferritic unit shows roller hearth.

this is built, the location of the fast cool zone precludes any changes. Cycle variations must be adjusted around this fixed point.

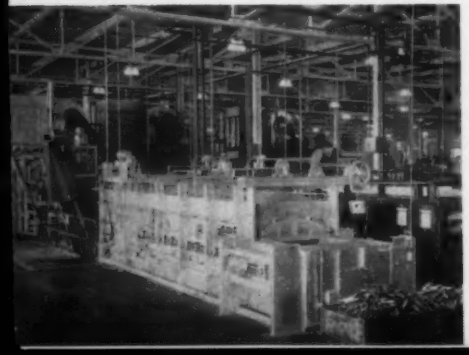
However it should not be implied that the continuous furnace is inflexible in its operation. It is possible to change the pushing cycle at any time from faster to slower or vice-versa. Actually the only obstacle in operating two or more different cycles simultaneously on different tracks in the same furnace is the ability of the gas generator to provide enough gas to adequately purge the furnace, or vestibules, as the type may be.

Either continuous overhead or floor furnaces are suitable for first stage pearlitic treatment. In fact, if a ferritic continuous furnace has sufficient heat input in the slow cool zone, it may be changed to a pearlitic cycle without cooling down, provided suitable air quenching facilities are available.



Gantry crane unloads battery of electric batch pearlitic furnaces.

Open-fired gas combination for oil quench and drawing of pearlitic.



One of the most important features of the pearlitic first stage furnace is the air quench. They have been built with air flows of up to 60 cfm per net pound of iron. More important than velocity is a design which insures uniformity of hardness and combined carbon in the cooled structure.

▪ **Reheat Furnaces for Oil Quenching—Pearlitic:** Furnaces for this purpose require little in the way of specialization over well designed continuous open-fired oil quench furnaces for steel parts. The work requires uniform heating to a temperature of 1575-1600 F with 20 to 30 minutes soak at hardening heat followed by a rapid quench in a good quality quench oil, rapidly agitated, at 120-170 F.

Pearlitic malleable is deep hardening and the characteristics impressed into it in each heat treatment are magnified in the following treatment. The emphasis is again in design to promote uniformity of treatment. This requires:

(1) At least two zones of automatic control in the furnace.
(2) Uniform heating rate along as well as across the hardening zone.
(3) Deep quench tank.
(4) Agitated and temperature-controlled quench oil.

Parts should be held at least 3 minutes in the oil and be withdrawn at a temperature of 150-350 F. The quench tank should have at least 2 feet of oil level above the quench convevor and preferably more (e.g., 5 feet). Quench chute should be water cooled and the chute long enough to realistically eliminate oil flashing in the chute. Fire protection must be adequate. Clean-outs for removing sand and scale around the discharge conveyor are necessary. Continuous hardening for heavy production is to be recommended over batch because of greater uniformity of heating and cooling rates.

At the present time controlled atmosphere hardening has not been found necessary since all work must be cleaned after drawing.

▪ **Tempering Furnaces for Pearlitic:** Tempering of either liquid quenched or air quenched pearlitic malleable iron is done between the temperatures of 1080 and 1400 F. Uniformity of response again depends upon uniformity of temperature and time treatment. In this temperature range except for the salt bath, only the high convection (electric or gas-fired) type of batch or continuous furnace can be recommended. Direct radiation ovens with or without "high-inspiration" open burners are incapable of the uniformity of control necessary to produce castings to standard specifications.

A great many designs of high convection furnaces for the treatment of steel are widely available and as far as general design is concerned may be very good for treating pearlitic parts. However, most of these are designed for a top operating temperature of 1250 F. This limitation is too restrictive for pearlitic as normal practice for tempering the softer grades (ASTM 43010, 45007, and 48005) may require draw temperatures in excess of 1300 F. Furnaces for tempering pearlitic require the use of higher chromium or nickel alloys in their manufacture as well as higher heat input than those designed to a 1250 F limit.

Both batch and continuous multizoned tempering furnaces find wide acceptance in this field. However, for high production with uniform casting sizes and loads, the continuous furnace will operate at very low man-hour and fuel costs.

▪ **Choice of Fuel for Annealing Furnaces:** Besides choosing between batch and continuous type furnaces, one must also select the fuel to be used.

Modern malleable heat treating equipment is virtually restricted to resistance type electric, or gas-fired radiant tube furnaces. This has largely developed from the acknowledged thermal inefficiency of pack annealing and developments in high temperature atmosphere control. Coal, oil or gas-fired pack annealing equipment has been made obsolete and a successful coal or oil-fired radiant tube has not been developed.

Substantially, a controlled atmosphere requires a closed heated chamber in which the atmosphere surrounds the work. The furnace must be capable of sealing off any

flue gas, air or undesirable gaseous contaminant, and maintain an effective gas seal which produces the desired metallurgical result.

Successful installations of both electric and gas-fired radiant tube furnaces are numerous and the choice is predominately one of local fuel or power cost and availability. In areas where natural gas is economically available, the unit cost of heating by gas and the cost of delivering the fuel at the desired pressure to the furnace is usually cheaper than the corresponding service by electricity.

Furnaces heated by either method are of full welded gas-tight-shell construction, and depend on the tightness of the shell and tightness of the door seals to prevent contamination of the protective atmosphere. A positive pressure must be maintained in the furnace to eliminate atmosphere contamination by air leakage. The shell must be pierced or cut to admit the ends of the heating tubes or heating element connections. In general, it is easier to maintain an effective atmosphere seal around the connector than around the tube. However, it must be conceded that troubles with tube sealing vary widely with burner and tube design, this trouble being almost unknown with certain types of radiant tubes.

When a radiant tube burns through, the tendency will be for the products of the combustion (H_2, CO_2, and H_2O) to enter and contaminate the furnace atmosphere, provided that this tube is fired under positive pressure. If the tube is designed to be fired under negative pressure, the tendency will be for the furnace atmosphere to be drawn into the tube upsetting the combustion slightly but not contaminating the atmosphere. The combustion disturbance is therefore an indicator of a leak to alert operators.

By comparison, electric elements do not contaminate the atmosphere when they burn out. As they oxidize or "age", their resistance changes and higher voltage must be applied to get the desired heat input. When they burn out, that sector of the furnace loses its entire heat input and the furnace must be shut down and cooled before the resistors can be repaired or replaced. Certain types of radiant tubes may be replaced while the furnace is operating without interference or delay to the output, cycle or quality of surface condition.

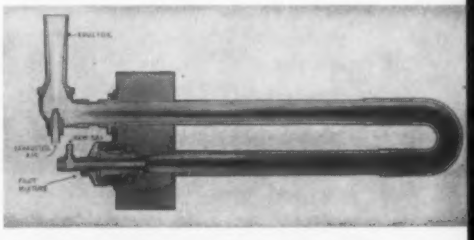
Radiant tubes also possess the desirable quality of being cooling elements as well as heating elements by simply shutting off the gas and blowing air through the tube. This gives great flexibility to operators in quickly correcting excessive temperatures, or adjusting to different cycles. In fact, this is the outstanding operating advantage of the gas heating over electric heating. Both types are capable of input heat control within the limits of their respective heat capacities.

■ **Choice of Alloy:** Any discussion of modern malleable iron heat treating furnaces must recognize the importance of sound alloy design and engineering if excessive maintenance and alloy costs are to be minimized. Since the cost of the alloy components in a modern continuous ferritic malleable furnace may be as high as one-third of its installed cost, and since normal full amortization of this alloy investment may have to be made every 5 or 6 years of operating service, careful attention to details of alloy design and fabricating technique pay big dividends. Unfortunately there are no clear cut rules of alloy design which will guarantee success to the inexperienced. In the field of modern controlled atmosphere annealing of malleable cast iron, most alloy failures are found to be primarily caused by:

(1) Improper design of the part.
(2) Poor fabricating technique (e.g., foundry defects in cast parts, cracks in welded members).
(3) High carbon in cast alloy.
(4) Creep, or deformation at high temperature due to excessive loads or temperatures.
(5) Abuse of alloy equipment by operating personnel (most alloy is non-ductile when cold).
(6) Inadequate maintenance when first failures are indicated.
(7) Inadequate attention to atmosphere control.

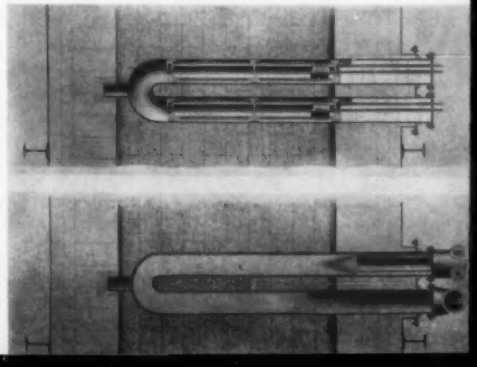
Likewise it is difficult to prescribe heat resisting alloys for all applications. Some alloy parts manufacturers offer proprietary alloys which, in some cases, have established excellent performance records. In general, malleable furnace requirements may economically be met in three basic chrome-nickel alloys, types 330, 310, and 309. Alloys higher in nickel than 330 alloy are not considered in this generalization due to present nickel procurement difficulties.

Parts subjected to maximum high temperature stress, oxidation or reduction reactions and thermal shock, such as trays and tray wheels, perform well under ordinary circumstances made in type 330 alloy. Where stresses are somewhat higher, but equal scaling resistance, and thermal shock resistance are required, as in tray boxes or work containers, type 310 alloy gives good service. For parts requiring somewhat less high temperature strength than either of the



Gas-fired radiant tube designed to operate under negative pressure.

Positive pressure gas-fired tube may also be used as protection for resistors for electric heating.



two previous classes but having to possess high scaling resistance, such as radiant tubes, type 309 is satisfactory.

■ **Maintenance:** No furnace should be purchased without careful consideration to the question of future maintenance and repair. Heating tubes and elements require periodic repair and replacement. The roller rail continuous furnace design is obsolete because the inability of lubricating the roll bearings made complete furnace shut-downs for roll replacement too frequent. Location of electric motors, power units and drives, electrical relays, limit switches, control instrument bearings, thermocouples, seals, motor valves, regulators, hand valves and cocks should be located for accessibility for repair as well as service.

A reliable furnace manufacturer will usually furnish a list of recommended spare parts to carry in stock. This is not a confession of an inferior piece of equipment, but insurance against production crippling delays for vital repairs.

A well designed continuous ferritic annealing furnace can operate over 3 years continuously, without shut-down for major repair. By comparison, 2 years for a batch furnace is a good record.

Frequent periodic inspection of trays, rollers, belts, retainers, grids or boxes by operators, inspectors or supervision is necessary. Tray rollers must be lubricated every cycle and this furnishes an excellent opportunity to check the condition of the tray and wheels. This close alloy inspection coupled with a program of preventive maintenance is the best insurance against furnace shut-down. Furnace operators develop an inherent pride in the equipment with which they work, and it is simple to teach them to make minor repairs and report parts needing maintenance department attention.

■ **Selection of Handling Equipment:** As accuracy of control and efficiency of operation is improved in modern heat treating equipment, the design becomes more specialized. Accessory to the furnace is the equipment needed to charge the furnace, discharge the furnace, handle the trays, pallets or boxes in which castings are being treated, load trays and unload trays or containers. This may be by overhead crane, lift truck, return rails, conveyor belt, mono-rail or by hand or combinations of methods. An arrangement which worked well for one plant may not necessarily be the best for another. However, in considering the installation of modern heat treating facilities, complete planning of all accessory handling equipment should be determined at the time the furnace equipment is being selected.

SELECTING CONTROLS FOR HEAT TREATING

Maximum benefits from modern furnaces can only be obtained if the installation also includes reliable and precise means for controlling temperatures of the castings being processed. Depending upon the type of the basic equipment, other controls may be desirable or even mandatory. These would include furnace atmosphere controls, automatic program controls, and peak electrical demand limitrols.

■ **Temperature Control Equipment:** Since the purpose of the equipment under consideration is the attainment of structural transformations in the metal by means of applied heat, it is of the utmost importance that control over the temperature of the work being processed be dependable and accurate. Hence the selection, location, and care of temperature control equipment is of prime concern to the malleable heat treater.

There are two basic components in the thermoelectric pyrometry system—the thermocouple and the pyrometer. While a wide combination of thermocouple materials may be used, the number has resolved into four types that are practical for malleable heat treating installations, listed in table below.

Iron-constantan couples are inexpensive, generate a high emf, and may be used in either oxidizing or reducing atmospheres. They are popular for batch-type installations. Although somewhat higher in cost, chromel-alumel couples find application in and somewhat above the

THERMOCOUPLES FOR MALLEABLE HEAT TREATING

THERMOCOUPLE	PRACTICAL WORKING RANGE	TYPE OF ATMOSPHERE	EMF AT 1800°F (REF 0°F)	RELATIVE COST
IRON-CONSTANTAN	0 - 1400°F	OXIDIZING	57.96 MV	LOW
	0 - 1800°F	REDUCING		
CHROMEL-ALUMEL	1000-2000°F	OXIDIZING	41.26 MV	RELATIVELY LOW
NICKEL-NICKEL MOLY.	TO 2000°F	OXIDIZING OR REDUCING *	49.21 MV	MODERATE
PLATINUM-PLATINUM RHODIUM	TO 2900°F	OXIDIZING *	9.46	HIGH
	TO 2700°F	REDUCING *		

* MUST BE PROTECTED FROM FURNACE ATMOSPHERE

Selecting thermocouples for heat treating applications.

practical range for iron-constantan. They are widely used in both batch and continuous furnaces. Suitably ventilated protection tubes are recommended when chromel-alumel couples are exposed to reducing atmospheres. The tube material is frequently a high chromium iron alloy (e.g., 27 per cent Cr). The higher cost of nickel and porcelain tubes generally preclude their employment in the malleable heat treatment department.

Gaining greater recognition are the nickel:nickel-molybdenum couples (18 per cent Mo). They are well suited to the range of malleable heat treating temperatures and, while their initial cost is high, give very good life when suitably protected in glass-sealed closed-end 36-16 stainless steel tubes. Besides good service life, these couples stay in calibration up to the end of their life, at which time failure becomes very apparent. Deterioration of other couples results in a gradual reduced efficiency, which, if not detected by frequent checking, can easily become a source of faulty heat treatments.

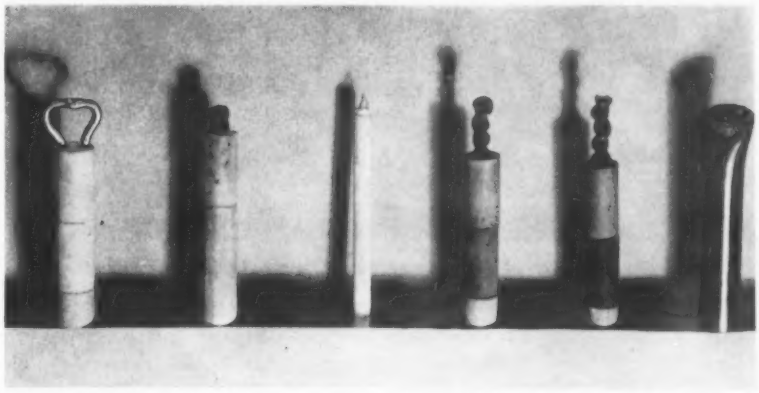
Because of their extremely high cost, low emf produced, and susceptibility to contamination by the atmosphere, platinum: platinum-rhodium thermocouples are not used to any extent in malleable heat treating furnaces. However, they do remain the universally-accepted calibration standard because of the excellent reproducibility of their calibration curve and because of their high accuracy over a wide temperature range.

While thermocouple wire may be obtained in bulk in two grades, the regular grade follows the standard emf curves closely enough for most malleable installations. Eight-gage wire is preferred over the smaller sizes, except for platinum: platinum-rhodium couples, where 24-gage is more practical. The hot junction of the couple may be made by tightly twisting, by twisting and welding, or by butt welding. There are some indications that the latter method gives greater accuracy.

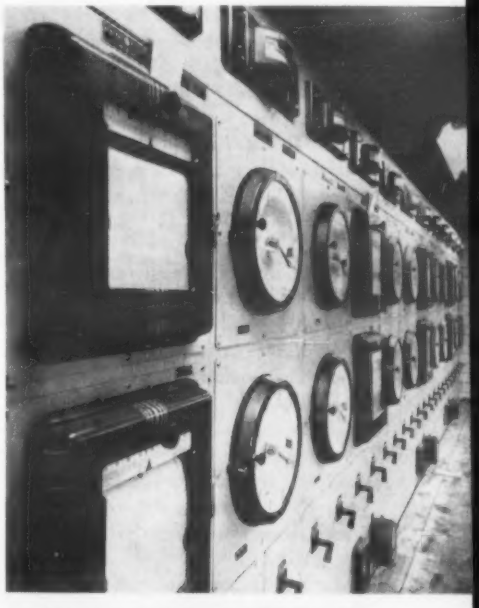
A routine program of frequent thermocouple calibration is important for consistent quality of product. The couple may be checked for low temperature accuracy by immersion in an ice bath. It is more customary, however, to check the couple within the commercial range of temperature in which it operates either by a portable potentiometer, converting the generated emf to temperature by conversion tables furnished by the wire supplier, or by actually comparing the service couple against a NBS-certified reference couple under identical conditions, such as in the same protective tube as the couple being checked.

It is poor practice to run the thermocouples to the very limit of their service lives. On the basis of past performance records, couples should be changed a reasonable time before failure is expected. A thermocouple is a relatively low cost item and the depreciated price of the timely-discarded one is insignificant when compared to the value of the castings being treated.

The number of thermocouples per furnace and their locations are determined mostly by the type of furnace. In modern batch furnaces, uniform heat distribution throughout the load is provided by surrounding the load with heating elements—either electric resistance ribbons or gas-fired radiant tubes. In such furnaces at least one thermocouple in the heart of the load indicates the temperature of the



Thermocouple hot junctions were made as follows: left to right, butt welded, tip welded, twisted and welded (Pt:Pt-Rd), twisted and welded (chromel-alumel), twisted, glass-sealed in alloy tube (Ni:Ni Mo).



Precise temperature control is the function of this instrumentation for a batch type furnace installation.

Furnace atmosphere analyzer lets furnace operators make spot checks.

Destructive testing. *Top*—step and wedge fracture clocks; *center*—tensile bars, before and after; *center, left*—impact wedge, before and after; *center, bottom*—tensile bar bent through 180 degrees; *left and right sides*—miscellaneous castings tested to destruction.

castings, while one or more couples in the furnace itself control the thermal input. Sometimes an additional thermocouple serves as a safety feature, in the event of failure of the furnace control couple(s).

In continuous furnaces, the temperature in each of the several zones is regulated by an individual recording controller. In addition, ports are usually provided along the side of the furnace for inserting thermocouples of portable instruments for check purposes.

Generally control couples project into the furnace four to six times their outside diameter and are so located that they are affected only by that heating unit which they control. Couples for recording load temperatures are usually longer so as to extend well into the center of the load of castings.

Lead wires between thermocouple and pyrometer may be of the same alloys as the couples themselves or, as in most installations, less expensive compensating lead wires may be employed. For example, chromel-alumel make satisfactory leads for nickel:nickel-molybdenum couples. The lead wires may vary from 24 to 14 gage, the heavier cross-sections being required for longer distances between thermocouples and pyrometer.

The second basic component of the thermoelectric system, the pyrometer, picks up the weak emf changes at the cold end of the thermocouple circuit, amplifies them, and converts them into mechanical energy of such a form that can be interpreted directly in thermal units or that can be utilized to activate electrical relays and switches or solenoid valves for temperature regulation in the furnace. Both continuous single point and intermittent multi-point instruments are available in either strip or dial recorders. The simple millivoltmeter type pyrometer has been largely supplanted by the null-balancing potentiometer. Electronic-balancing instruments, utilizing electronic detection and amplifying circuits, are becoming increasingly popular where ruggedness and instantaneous response to temperaature changes are desired. Batch installations incorporate program controllers to automatically regulate the time-temperature cycles according to predetermined settings, thus virtually eliminating dependency on the human element and assuring uniformity of treatment from heat to heat.

■ **Atmosphere Control Equipment:** Regulation of the heat treating furnace atmosphere is important from the standpoint of scaling, decarburization, and properties of the castings being processed. With modern batch-type furnaces there is no longer any need for packing material and for mudding up the pots. Seals between the furnace and door or car or base permit the highly reducing atmosphere, self-generated by the castings themselves during the initial portion of the cycle, to be retained and thus protect the load from scaling and excessive decarburization. Therefore, special atmospheres are rarely used in batch-type installations.

Quite different however are the continuous furnaces which have to be opened periodically for each push. In such units synthetic atmospheres become most desirable, particularly in the charging chamber, to dilute or purge out the oxidizing gaseous components or to render the atmosphere reducing with respect to the castings. In such installations, control of the synthetic atmosphere and the general furnace atmosphere becomes obligatory, not only to assure full protection for the castings, but also to guard against the generation of explosive conditions.

The control equipment may be of the continuous automatic type or it may be only for spot checking and manually operated. Most of the constituents in the furnace atmosphere differ from one another in their thermal conductivity, specific gravity, magnetic susceptibility, infra red absorption, and chemical reactivity. Advantage has been taken of these characteristics in the development of continuous devices for measuring, recording, and/or controlling the atmosphere. The proportion of oxygen and combustibles in a gas may be determined by igniting them selectively under controlled conditions. The heat so generated alters the electrical resistivity of the platinum wire in the chamber that forms one leg of a wheatstone bridge circuit, so the gas composition changes are read directly from a dial indicator.

Although much slower, a manually operated chemical absorption apparatus, such as the Orsat, is capable of accurately analyzing specific components of the atmosphere. Equipment that is also important with respect to atmosphere control

would include the dew point analyzer, either manual or continuous, and the temperature and flow gages on the generator combustion chamber.

▪ **Product Control Equipment:** While quality tests on work that has already emerged from heat treatment are basically historical controls, they do provide a means for detecting faulty processing so that corrective measures can be taken for future production. Such tests may be destructive or non-destructive. Included in the former category would be bend tests on scrap castings, fracture tests on lugs, wedges or step blocks, tensile tests, impact tests, or microscopic examinations of the processed material. All well-equipped malleable plants have facilities for conducting such tests.

As far as non-destructive tests on the castings themselves go, the determination of Brinell hardness is the most widely employed. In the hand-operated Brinell machine the 3000-kg load is applied through dead weights either on a multiplying lever system or by a hydraulic loading cylinder. Due to the need for faster testing equipment, machine-loaded and direct-reading instruments have come into general usage for production testing. It has been estimated that by employing suitable fixtures to locate and hold the castings such machines are up to six times as fast as the hand-operated models. Constant checking of production hardness testing apparatus is essential through the use of standard test blocks or proving rings.

The consensus of opinion among quality control people is that a flat smoothly-ground surface is imperative for reproducibility of hardness results. Surface grinders come into service for this purpose. A slight upset, pad or boss on each casting is helpful.

In order to take a Brinell hardness reading the width of the casting surface to be tested must be at least 2-1/2 times the diameter of the impression and the casting thickness must be at least 10 times the depth of the impression, according to A.S.T.M. specification E10-54T. Frequently small malleable castings do not possess the required thickness or surface, so a Rockwell test is substituted. Caution must be observed in converting Rockwell values of Brinell, since the widely-published tables for "unhardened steel, steel of soft temper, gray and malleable cast irons" actually are not accurate for standard and pearlitic malleable irons. Also, because of the relatively small size of the penetrator, it is best to provide a smoother surface than for the Brinell and to take a number of Rockwell readings on each casting, particularly with ferritic malleables and low-hardness pearlitic malleables which tend toward a wider scatter of readings.

SELECTING EQUIPMENT FOR MINIMUM COST

Malleable heat treating furnaces are very expensive due to the extensive use of alloy steel in their construction. Such a furnace with atmosphere generator may easily cost from $150,000 to $350,000.

The furnace should be designed so that it can be used to produce both pearlitic and ferritic malleable iron. With the increasing demand for pearlitic iron, a furnace which can be used only for ferritic malleable iron may become obsolete and additional expense will be incurred in setting up to produce pearlitic irons. Another factor to be considered, is the ease with which a furnace may be banked on week-ends. With the ever-increasing demands of labor, manufacturing costs rise rapidly if the furnaces are operated at premium pay over the week-end. When purchasing new equipment, be certain that the furnaces can be banked over week-ends and holidays without any undue hardship on the equipment.

The factors which govern the selection of fuel will be dependent upon the availability of an uninterrupted supply and the prevailing fuel rates. Generally speaking, the gas rate is more favorable than the electric, and the cost of fuel is about 2 to 1 in favor of the gas. If natural gas can be purchased on a non-interruptable basis at a moderate rate, the gas cost will be very attractive. The gas consumed will vary with the type furnace, B.T.U. value of the gas, length of cycle, and operating temperature.

Warpage of grids, trays, and sand seals is common to the batch furnace and cleaning costs are usually high unless atmospheres are used. Due to the longer time interval in furnace, decarburization is greater.

In the continuous furnace, alloy life is an important cost item. Proper handling of baskets and preventive maintenance play a role in obtaining maximum alloy life.

Controlled atmospheres such as dry nitrogen improve alloy life of furnace accessories, and reduce maintenance costs.

Annealing atmospheres, although they add to the cost of the process directly, have reduced some of the indirect expense from the operation. A high nitrogen atmosphere unit costs about $0.30 per hour to operate. This includes maintenance costs on the unit.

If thermocouples are not carefully selected they can become an expensive cost item. The chromel-alumel couple has proven to give the lowest operating costs, since they can be made by technicians in the foundry. Nickel-nickel molybdenum couples are made by the manufacturer since they must be hermetically sealed. When one of these couples fail, the entire protection tube and couple must be removed and returned for repair. The iron constantan has a lower initial cost. However, the life is

shorter and there are limitations on the use of this type of couple.

Direct labor costs for packing, loading, and dumping will be much lower on continuous furnaces than with batch furnaces. One furnace tender can handle two continuous furnaces; pack, load and dump. Batch furnaces, on the other hand, require the services of one overhead crane operator, shop truck operator and usually two men for packing. Handling equipment for proper flow of material through the department is an important accessory to modern heat treat equipment. Tote boxes and shop trucks are very expensive. Storage bins and conveyors are more economical.

As a matter of comparison of annealing costs, the following statistics in Table I show the variations in annealing.

Table I

	Gas Continuous	Electric Continuous	Coal Fired
Fuel	$1.60	$ 3.80	$ 2.25
Labor	2.00	2.00	4.00
Pots	1.25	1.75	10.00
Alloy	.15	.80	2.00
Maintenance	.50	.75	2.00
Atmosphere	.30	...	...
Control	2.00	2.00	2.00
	$7.80	$11.10	$22.25

Fuel efficiencies in figuring heat treat equipment are rated as follows:

Fuel Oil	40%
Natural Gas	58%
Electric	85%

Depreciation costs and interest on instruments must also be added into the actual annealing cost. The span of obsolescence on modern heat treat equipment today should be about 10 years. In setting up the rate of amortization, it will depend on company policy and initial installation cost. With the modern improvements in heat treat equipment and the tonnages being annealed today a 10 year period of amortization is reasonable. When dealing with alloy and tray cost, a monthly write-off should be included in the cost. In the following Tables II and III, the tray cost includes replacement of 3 trays per month.

Table II CONTINUOUS FIRED GAS FURNACES

	Plant A	Plant B	Plant C
Alloy Cost	.115	.520	.150
Maintenance	.036	.042	.080
Atmosphere	.150	.200	...
Tray Cost	1.110	1.300	1.850
Gas Cost	1.170	1.680	2.620
Power Cost	.150	.150	.250
Depreciation	3.750	3.500	3.750
Interest	3.000	3.000	3.000
Cost Per Net Ton	$9.481	$10.395	$11.700

Table III CONTINUOUS ELECTRIC FURNACES

	Plant D	Plant E	Plant F
Alloy Cost	.215	.205	.305
Maintenance	.085	.055	.045
Atmosphere	...	...	...
Tray Cost	1.800	2.000	1.850
Gas Cost	...	...	...
Power Cost	3.850	4.290	4.010
Depreciation	5.250	5.000	4.750
Interest	4.500	4.000	4.000
Cost per Net Ton	$15.700	$15.550	$14.960

The cost of pearlitic iron produced in gas and electric continuous furnaces will be only the increase in fuel cost. This additional cost will be from $0.65 to $0.90 per ton. Reheat and oil quench pearlitic will have additional cost for reheat and oil quench amounting to between $0.75 and $1.25 per ton above the malleable cost.

POUR-FEED COMBINED IN SPRUE-RISER

Unique cores produce a double-duty sprue-riser that acts as a pouring basin, then switches to a riser

LARRY DEBOER / *Metallurgist*
Southern Wheel Div.
American Brake Shoe Co.

Design of a unique set of cores has enabled the Southern Wheel Div., American Brake Shoe Co., Calera, Ala. to combine a pouring sprue and a riser.

Used to cast steel railroad car wheels, the cores consist of a gate core and a center core. The gate core is similar to a large circular strainer core and has a triangular shaped hole in the center surrounded by 12 equally spaced pouring or "pop" gates.

The center core is circular and consists of three equally spaced ears for support, three equally spaced feeding gates, and a center cavity.

These cores provide small pouring gates insuring a choked pour but at the same time producing a large feeding gate to insure a sound casting.

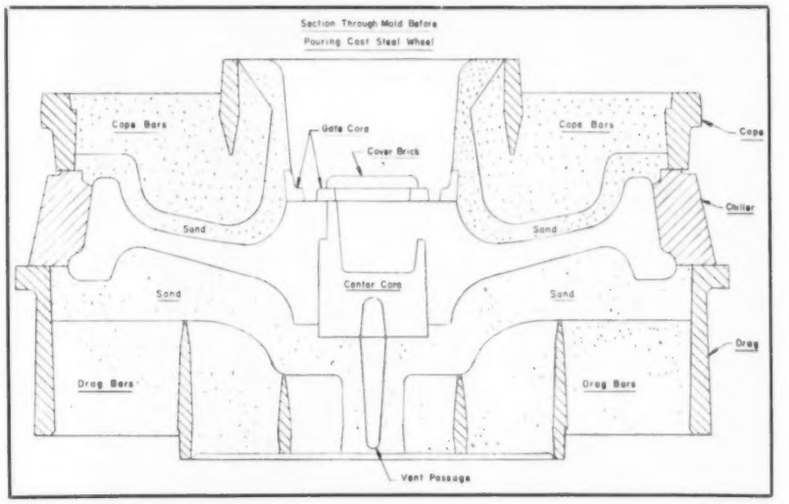
The gate core is rammed into place in the cope. The triangular shaped hole is covered by a circular brick during pouring, allowing the molten steel to enter the mold cavity through the pop gates. The pouring basin is filled immediately and kept full during pouring so that any slag or dirt will stay on top of the basin. The rate at which the mold is filled is controlled mainly by the diameter and number of pop gates.

The brick remains in place over the feeding gate during pouring because the metal pressure above it in the pouring basin is greater than the gas pressure below in the partially filled mold.

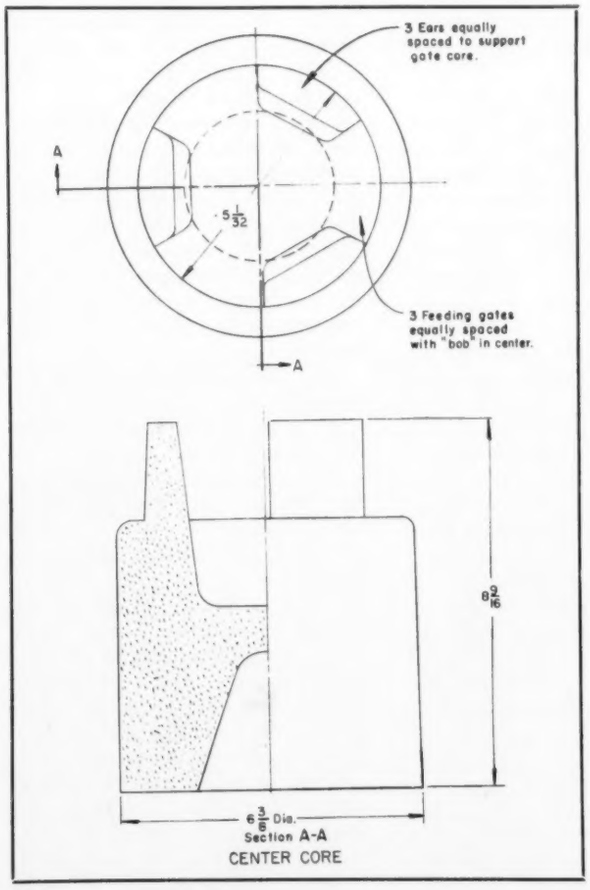
After the mold and basin are filled, the brick is completely surrounded by molten steel and it floats off of the feeding gate. The pouring basin now becomes a riser.

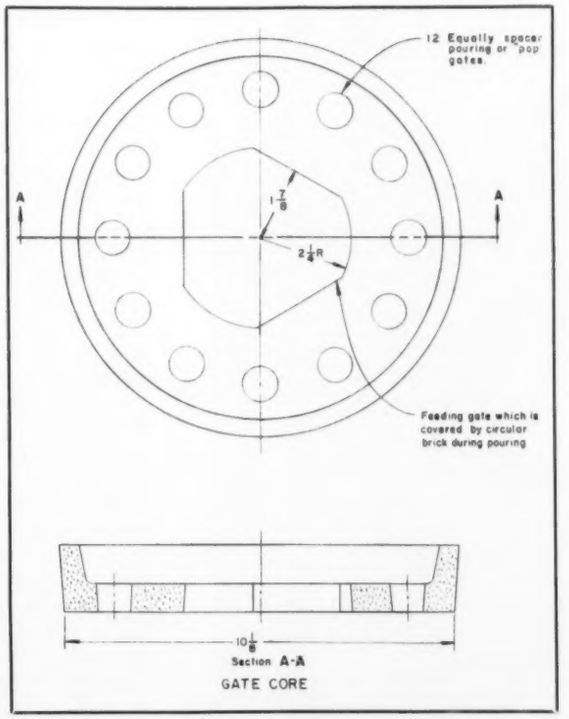
Molten steel feeds from the riser through the large triangular gate in the center of the gate core into the bob or cavity in the center of the hub core and out into the hub of the wheel through the three feeding gates between the hub core ears.

Feeding is completed in 50 minutes at which time the cope is lifted, taking the riser with it. The design of the gate core gives a clean breaking plane between the riser and hub. The last step in removing the riser and gating from the casting is cutting the three feeding gates between the "bob" and the hub, which leaves a clean bore.



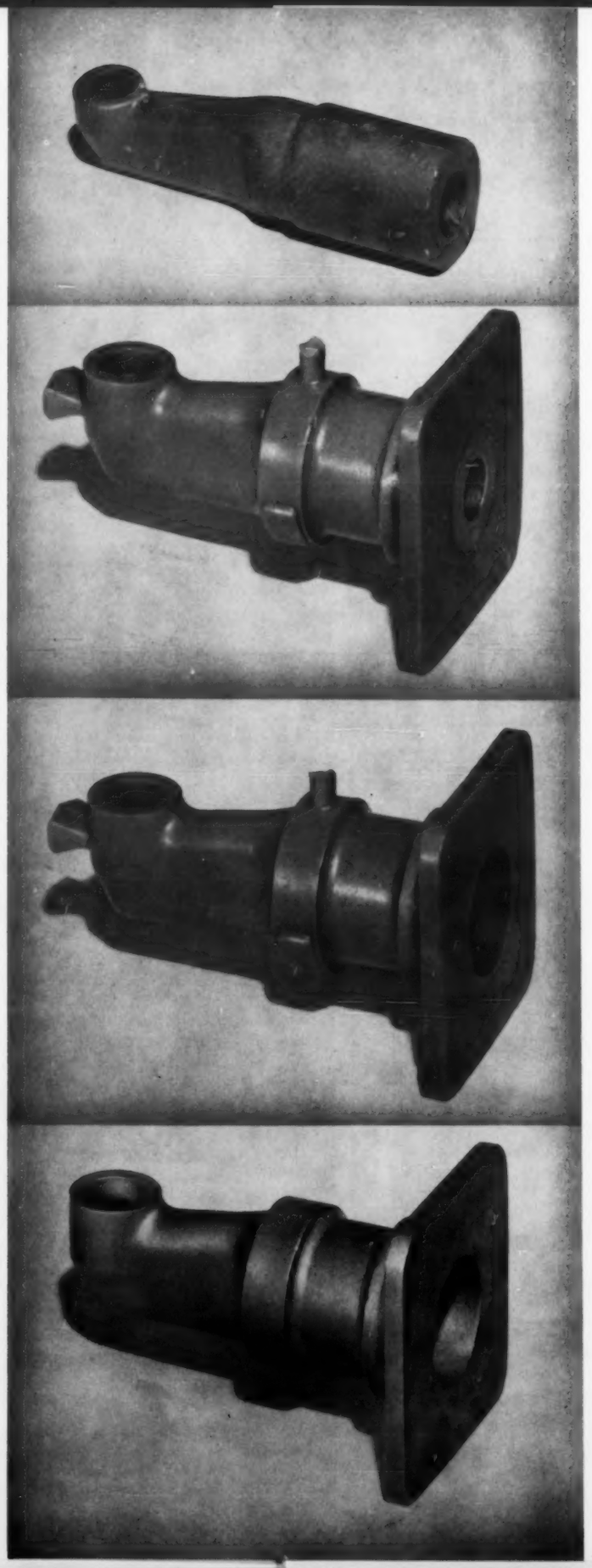
Cover brick floats off when mold is filled and basin becomes a riser.





Gate core is similar to a large strainer core.

Circular center core has three feeding gates.



SOLUBLE WAX CORES Solve the Impossible

C. W. SCHWARTZ / *Technical Director*
Misco Precision Casting Co.

Wax-mica material makes accurate cavity cores, forms difficult contours for investment castings

Do designers ask the impossible of investment casters? Certainly design engineers today are aware of the possibilities of investment casting and they are incorporating multi-sectional hollow cavities and other complex contours in hollow castings that are practically impossible to make. Impossible to make, unless you use the soluble wax core technique.

The problem of producing a hollow casting in which the core can not be directly retracted has confronted investment casters before, and there are two common mechanical methods for solving the problem. These methods fall short of meeting all of current design requirements, however.

The two mechanical techniques are (1) the use of split section retractable metal cores, and (2) the use of split section wax or plastic patterns which are fixture welded or cemented to form the whole pattern. Metal cores are generally used only on straight machined sections. The difficulties with this approach are that there is wax flash into the section parting lines and it is usually impossible to section the core for removal where difficult internal contours are encountered. Principal objection to the second method is that perfect cementing or joining of the sections is difficult and there is usually a crack at the parting line where the dip coat penetrates.

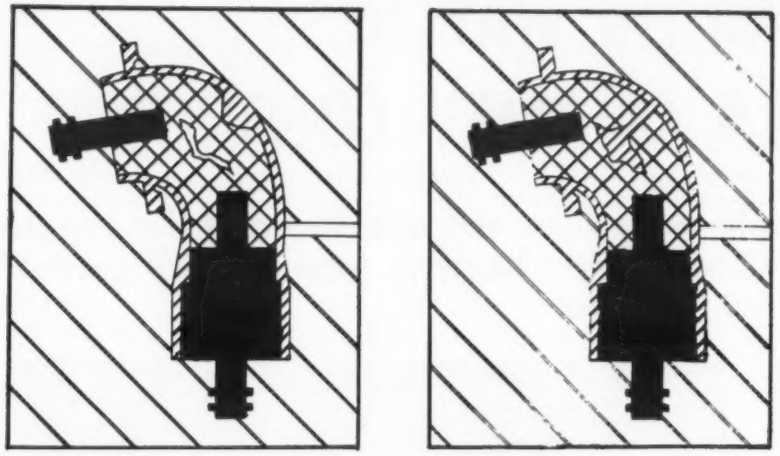
When a casting is designed so that an internal cavity must be formed in such a shape that it is impossible to remove these rigid cores, water soluble wax cores are often the answer. For this method, a die is designed that permits the core to be formed by the usual wax injection technique. However, instead of using a conventional investment casting wax, the core is made from a wax which not only melts at elevated temperature but also dissolves in water. A core of this type is then positioned in the die used to form the "lost wax" pattern and wax is injected around the core.

The wax pattern containing the water soluble core is then placed in water where it dissolves leaving the desired hollow wax pattern.

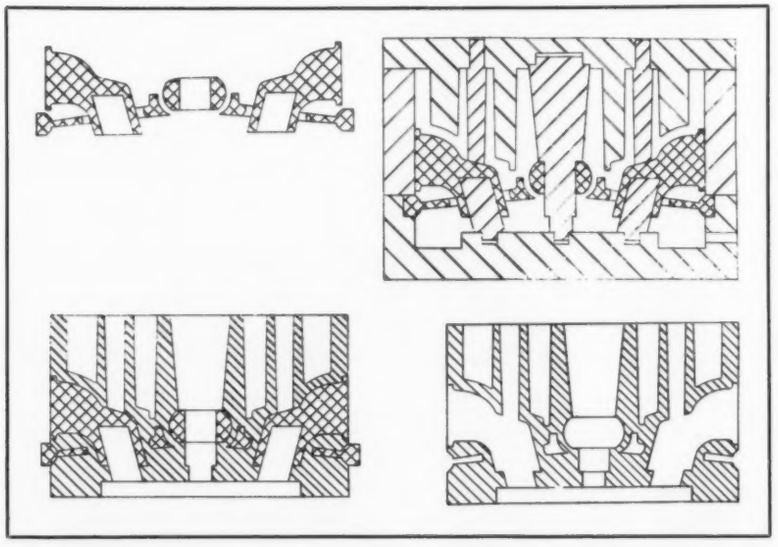
This procedure is illustrated in the step-by-step photographs of the production of a typical aircraft plumbing type casting. Brass core prints are used to locate the soluble wax in the die cavity for the pattern injection. These brass prints reduce the amount of soluble wax needed and by extending into the wax they create an initial cavity which reduces the time required to dissolve the mass.

Considerable experimentation was done at Misco before we developed a suitable material for making soluble cores. The final development was a mixture of solid

Sequence starts at top with water soluble core, pattern wax injected around the core, soluble wax dissolved, and the finished steel casting.



Shrink voids may occur with soluble wax during cooling. Allowing injected pattern wax to enter through small holes prevents collapse.



Soluble wax cores for diesel engine cylinder head appear at upper left. Upper right indicates wax and removable brass cores positioned in die. Pattern wax has been injected around core assembly at lower left. Final drawing shows completed pattern with cores removed.

polyethylene glycol and 160 mesh powdered mica mixed in the ratio of 1 mica to 2 wax by weight.

Mica is employed in this mixture as a filler because the wax is too weak to carry the applied load.

The blend of wax and mica is injected with conventional equipment at a temperature of 150 to 155 F and a pressure of 1000 to 1500 psi. Silicone grease is used as a parting agent and dwell cycles during injection vary from 30 seconds to 5 minutes, depending on the mass of the injected core. This operating data is a guide only and does not apply to all types of patterns. Differences in mass and shape will require different techniques.

The soluble core is dissolved in a tank of circulating warm water. Caution must be exercised to maintain the water temperature within a 90 to 100 F range. The water temperature must not be allowed to rise above the temperature at which the pattern wax will deform.

Another problem encountered in the production of the soluble cores is the formation of shrink voids in the wax as the solidifying mass contracts. If no counteraction is taken, a core containing voids will be crushed when pattern wax is injected around it. Such collapse would form lumps on the core walls of the pattern which would be very difficult to control or remove. To avoid this, small holes can be drilled through the soluble core to the shrink voids. As the pattern wax is injected these voids will be filled with pattern wax before pressure can be built up to cause collapse. After the soluble core is dissolved, the excess pattern wax can be removed.

The diesel engine cylinder head pictured illustrates the complexity of patterns that can be made with soluble cores. Note the four ports for the exhaust and intake manifolds. A complex hollow cooling chamber was located radially around the lower section of the ports. To further complicate the problem, a spherical inner precombustion chamber was located in the center of the casting. Brass inserts were used to form hollow sections of the pattern wherever straight retraction was permitted, and a total of six soluble cores were used to complete the pattern. In the case of this particular casting, the soluble cores were used only during the development work that was carried on to perfect the part. The part was redesigned for a welded split section wax pattern when it went into quantity production.

The soluble core technique has been developed to a satisfactory degree, but it will be used for only a small part of normal production. The tooling and labor involved are expensive. However, many commercial castings with complex hollow sections are successfully made with soluble cores when conventional methods fail.

Condensed from a presentation at the Fourth Annual Meeting, Investment Castings Institute.

Cylinder head illustrates complexity of castings that can be made.

CHARTING THE WAY TO CUPOLA QUALITY CONTROL

Five simple records on the operation of the cupola are the foundation of gray iron quality control

MORRIS GITTLEMAN /
Pacific Cast Iron Pipe & Fitting Co.

Hopes for increased foundry production, whether or not it includes mechanization, are keyed to control. Improved control of the foundry product can be initiated with an understandable system of recorded information. Always a vital factor in meeting customers' requirements, control and records becomes increasingly important when applied to automation and the adoption of new techniques.

A record-keeping program for cupola control has applied at Pacific Cast Iron & Pipe Fitting Co. to aid gray iron quality control. The forms may be modified to fit other foundry operations.

Control begins with raw materials. These usually consist of pig iron, scrap, returns, steel, coke, air, ferro-alloys of silicon and manganese, inoculants and fluxing materials.

Before controlling raw materials it is necessary to know the conditions and ranges of properties under which they will perform satisfactorily. This is obtained from prior plant experience and available recorded records in similar circumstances. The knowledge is projected to dovetail with present operations and serve as a guide in formulating specifications for raw materials. An example of such specifications is shown in Fig. 1.

Incoming cars are checked for conformity with specifications by the plant laboratory. The supplier is required to confirm in writing compliance with the agreed specifications. This brings an important consideration.

A specification must not only fulfill the requirements of the operation it is intended to serve, but should also be practical enough for the manufacturer and/or supplier to be able to comply with under normal conditions. Such specifications should be designed so that materials can be readily checked for conformity without burdensome and elaborate controls. In such manner specifications for scrap cast iron, steel, ferro-alloys, fluxing materials, refractories and inoculants can be established.

These materials should have adequate storage space in the yard so their identity and purity are maintained with minimum waste. It is only when the raw materials are controlled that the cupola charge can maintain uniformity.

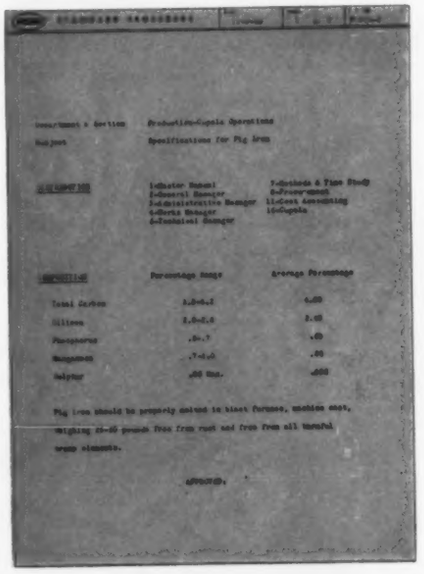
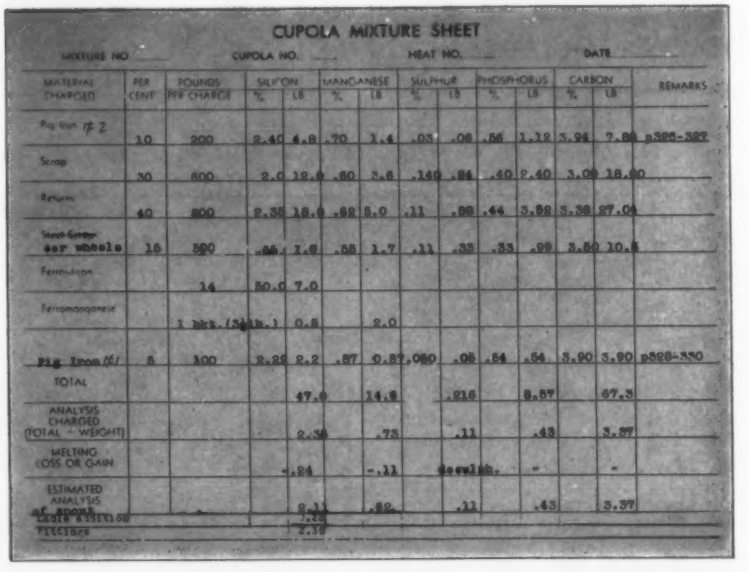


Fig. 1 . . Materials specification.



CUPOLA MIXTURE SHEET

MIXTURE NO. _____ CUPOLA NO. _____ HEAT NO. _____ DATE _____

MATERIAL CHARGED	PER CENT	POUNDS PER CHARGE	SILICON %	SILICON LB	MANGANESE %	MANGANESE LB	SULPHUR %	SULPHUR LB	PHOSPHORUS %	PHOSPHORUS LB	CARBON %	CARBON LB	REMARKS
Pig Iron #2	10	200	2.40	4.8	.70	1.4	.05	.08	.56	1.12	3.94	7.88	p328-329
Scrap	30	600	2.0	12.0	.60	3.6	.140	.84	.40	2.40	3.00	18.00	
Return	40	800	2.38	18.8	.62	5.0	.11	.88	.44	3.52	3.38	27.04	
Steel Scrap car wheels	10	200	.86	1.6	.58	1.7	.11	.33	.33	.99	3.50	10.8	
Ferrosilicon		14	50.0	7.0									
Ferromanganese		1 bag (50lb.)		0.8		2.0							
Pig Iron #1	5	100	2.35	2.2	.87	0.87	.080	.08	.84	.84	3.90	3.90	p328-330
TOTAL				47.0		14.8		.216		8.87		67.3	
ANALYSIS CHARGED (TOTAL ÷ WEIGHT)				2.34		.73		.11		.43		3.37	
MELTING LOSS OR GAIN				-.24		-.11		Overlab.		-		-	
ESTIMATED ANALYSIS of spout				2.11		.62		.11		.43		3.37	
Cupola Tap(s)				2.10									
Ladle				2.10									

Fig. 2 . . Cupola records shows what, and how much, is charged.

In calculating a cupola charge we must be concerned with the following considerations:

1. Under the controlled melting conditions that prevail, this unit mixture of raw materials, should, on emerging in the molten state, possess the desired chemical and physical properties.
2. This charge must lend itself to accurate weighing, charging and successful melting on a uniform and secure production basis.
3. Of the many mixtures capable of fulfilling the requirements, the one that is lowest in cost is most desirable.

Figures 2 and 3 illustrate these basic aspects in the formulation of a cupola charge.

Figures 2 and 3 translate this charge into its chemical and cost components. It is important that this charge meet the pouring and service requirements of the castings at minimum cost per ton of metal at the spout, or per ton of good castings.

The impact of a proper charge upon cost can perhaps be better appreciated when, referring to Fig. 3, we add to the charge, what would apparently seem to be one insignificant extra briquet of silicomanganese. For 200 charges this unnecessary additional briquet amounts to $92.00 a day or approximately $23,000 a year. This is a trifle dollar-wise, compared to the loss that could be sustained in misruns, cracking and other casting rejects if the original briquet of manganese was excluded to save money. The cost of misuse of coke and pig iron in a charge is clear.

Materials entering the charge should be accurately weighed. There should be one scale for the ferro-alloys, another for coke and the fluxing materials and a third for the heavy metallic components. Scales should be checked for accuracy, serviced at regular intervals, and always kept clean.

The cupola should be prepared accurately to dimension with a secure refractory lining. Such dimensions as the diameter of the melting zone, effective area of tuyeres, height of coke bed, tap hole diameter, vertical distance from the top of the tap hole to lip of the slag spout, as well as the contours of the lining not excluding the bosh and the sand bottom—all impose ranges on the cupola operation and define the extent of the melting process.

Let us say then that in the light of sound foundry practice we have

chosen siutable operating dimensions. The best test of their serviceability must necessarily be proven by the operation itself. If a 60 in. diameter in the melting zone gives approximately 14 tons per hour, then 60 in. is the correct dimension. If in the light of a normal wind box pressure of 16 ounces, it is decided to make the vertical distance from the top of the tap hole to the highest point in the trough on the side of the slag dam away from the cupola 4½ in., and this is giving us a good slagging operation—then here too we have the desired dimension.

It is good to deal in units when formulating procedures. Preparation of the tap hole, trough, coke bed, sand bottom, are examples. It may be convenient to further subdivide a unit operation into several components. Thus the cupola sand bottom procedure (Table 1) can be subdivided into mixture of sand used, its range of properties, and the method for proper installation. Under the overall procedure dealing with the cupola lining there are such subdivisions as well zone, melting zone, charging zone, stack zone. Varying service requirements in these cupola zones provide the logical reason for the subdivisions.

Control over cupola preparation can be exercised through such procedures. They should be clear, practical and yet sufficiently detailed to cover the operation securely. The operator merely follows a procedure that has been proven correct and the cupola has contours and dimensions that are desirable. Control becomes a check on the overall dimensions or contours, providing the routine details of the procedure are followed. Tables 1 and 2 list procedures for the preparation and installation of a cupola sand bottom and the preparation of a cupola coke bed, respectively.

A technical observer checks the cupola operation each hour, reporting this on Fig. 4 what is being charged. He fills in the control data associated with the cupola. Unusual conditions are noted in remarks.

The first test on the metal is a temperature check at the spout. For cast iron the optical pyrometer is used.

TABLE 1: PROCEDURE FOR CUPOLA BOTTOM

A. Mixture of unit batch—4 batches required
   1) 300 lb fitting system sand.
   2) 100 lb Ottawa silica sand.
   3) 9 lb fire clay.
   4) Water to desired moisture.
   5) Mull approximately 7-10 min. in paddle mixer.
   6) Convey batch to storage bucket. Cover bucket.

B. Desired Physical Properties
   1) Permeability 60-80.
   2) Green compression 7.0-11.0 psi.
   3) Moisture 4.5-6.0 per cent.

C. Procedure for Installation
   1) Inspect closed bottom doors and well area. Clean and remove all contaminents.
   2) Convey bucket with approximately 1600 lb sand through charging door and drop on bottom doors.
   3) Spread sand evenly over bottom doors.
   4) Starting on the outside edge ram sand making a wide fillet against the lining. Ram circumferentially moving towards center. Ram several times until desired hardness is obtained.
   5) Slope bottom sand at all points toward tap hole approximately 1 in. per foot.
   6) Using clean paper from silica sand bags cover sand bottom. Cover paper with pieces of coke to hold in place. Secure tap hole with coke bridge.

TABLE 2: PREPARATION OF CUPOLA COKE BED

1. Drop 2½ charging buckets of coke on sand bottom.
2. Insert gas burners into 4 tuyeres and tap hole and light up coke bed. Allow coke to burn thus for approximately 45 min. Be sure that coke in well area is sufficiently burned in. Remove burners. Close tuyeres and turn on blower for approximately 8-12 min. or until the coke bed becomes a bright cherry color throughout.
3. Shut off blast and close tap and slag holes.
4. Add coke to bed until rod extended from charging door sill shows 60 in. from the top of the tuyeres to the top of the coke bed.
5. Begin to charge.
6. When charging is complete put on blast.

Metal temperature is the net result of the cupola combustion processes. Temperature readings falling in desired range, give good indication of a corresponding satisfactory range of melting conditions in the cupola—such as bed height, wind volume, coke charges, wind box pressure. These temperature readings are taken hourly. Spout temperatures are controlled in the range of 2740 to 2780 F.

Chill and Brinell tests are made hourly. Chills for the base metal which goes into pipe, not subject to machining, are controlled from 3/32 in. to 5/32 in. Metal scheduled for fittings and castings that undergo machining, have a 0.25 per cent silicon addition to the ladle and are controlled to a 2/32 in. maximum chill and a maximum Brinell realing of 235. All metal is initially inoculated at the spout with a proprietory material before entering the receiving ladle to promote a desirable graphite formation through nucleation of solidification centers, to help serve as a mean. for deoxidation, to reduce chill and to improve fluidity.

Given a base iron of desired and uniform composition at the spout it is good practice to effect the final 0.2 to 0.4 per cent silicon by

DAILY HEAT REPORT

Cupola No. 4 Number of Charges 1 Date

Wind On Wind Off

MATERIAL USED IN HEAT			UNIT PRICE	TOTAL PRICE
Pig Iron No. 1 Pile	100 Lbs.	Tons	per ton 12.99	3.15
Scrap Iron	600 Lbs.	Tons	40.89	12.22
Returns	800 Lbs.	Tons	45.31	16.12
Steel Car Wheels	300 Lbs.	Tons	40.20	6.05
Pig Iron No. 2 Pile	200 Lbs.		52.02	5.20
Total Metal	2000 Lbs.	Tons		45.74
Coke	220 Lbs.	Tons	37.70	4.84
Bed Coke	20 Lbs.	Tons	37.70	0.87
Total Coke	240 Lbs.	Tons		4.91
			per cwt	
Silicon (80%)	Briquets	14 Lbs.	7.34	1.05
Manganese	Briquets	8.5 Lbs.	10.10	0.86
Phosporous	Briquets	Lbs.		
Purite	Briquets	4 Lbs.	5.52	0.22
Limestone	60 Lbs.		per ton 7.25	0.22
Innoculant	1.5 Lbs.		10.62	0.39
80% Ferro-Silicon		33 Lbs.	17.52	0.58
				2.74
			Total	53.50

Fig. 3 . . Heat record presents the bill for the charge.

CUPOLA CONTROL DATA

CUPOLA B DATE May 22 1956

#1 Pig Iron 100 lbs. Blast Vol. 7000 cfm

#2 Pig Iron 200 lbs. Blast Pr. 16 oz.

Returns 800 lbs. Output Pr. 7 psi

Scrap 600 lbs. Supply Pr. 17 psi

Car Wheels 300 lbs. Amps 90

Steel Scrap — lbs. Ladle Add 3.0 lbs.

Coke 230 lbs. Inoc. CK

FeSi(50%) 14 lbs. Desul. 1 Bkt.

Mang. 1 briq. Tuyeres Clear

Soda Ash 1 briq. Slag Bottle Green

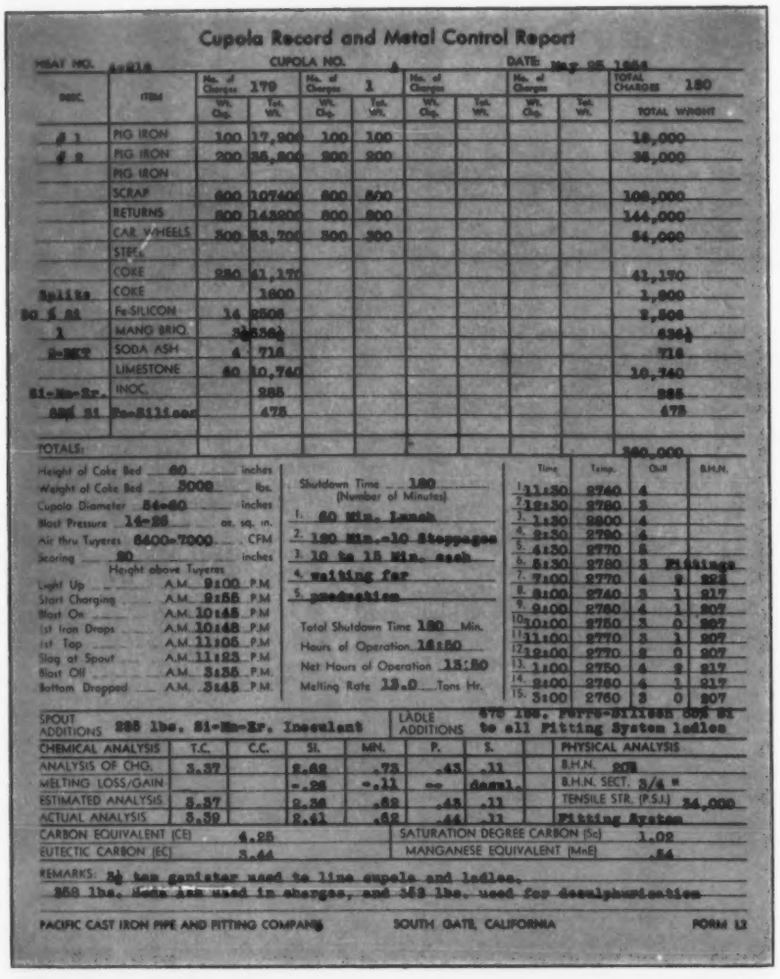
Limestone 60 lbs. Temp. 2770 deg. F

Time 2:00 p.m. Tested by Pm

REMARKS: Cupola 1 Charge Iron

Pacific Cast Iron Pipe and Fitting Co., So. Gate, Calif.
Form L-5

Fig. 4 . . Technician reports hourly on cupola condition.



Cupola Record and Metal Control Report

HEAT NO. A-818 CUPOLA NO. A DATE: May 25 1954

DESC.	ITEM	No. of Charges 179 Wt. Chg.	179 Tot. Wt.	No. of Charges 1 Wt. Chg.	1 Tot. Wt.	No. of Charges Wt. Chg.	Tot. Wt.	No. of Charges Wt. Chg.	Tot. Wt.	TOTAL CHARGES 180 TOTAL WEIGHT
# 1	PIG IRON	100	17,900	100	100					18,000
# 2	PIG IRON	200	35,800	200	200					36,000
	PIG IRON									
	SCRAP	800	107400	800	800					108,000
	RETURNS	800	143200	800	800					144,000
	CAR WHEELS	300	53,700	300	300					54,000
	STEEL									
	COKE	230	41,170							41,170
Splits	COKE		1800							1,800
50 # ea	Fe-SILICON	14	2508							2,508
1	MANG BRIQ	3	536½							536½
2-BKT	SODA ASH	4	716							716
	LIMESTONE	60	10,740							10,740
Si-Mn-Zr.	INOC.		285							285
285 #1	Fe-Silicon		475							475
TOTALS:										380,000

Height of Coke Bed 60 inches
Weight of Coke Bed 5000 lbs.
Cupola Diameter 54-60 inches
Blast Pressure 14-26 oz. sq. in.
Air thru Tuyeres 6400-7000 CFM
Scoring 20 inches
Height above Tuyeres
Light Up A.M. 9:00 P.M.
Start Charging A.M. 9:56 P.M.
Blast On A.M. 10:46 P.M.
1st Iron Drops A.M. 10:48 P.M.
1st Tap A.M. 11:06 P.M.
Slag at Spout A.M. 11:23 P.M.
Blast Off A.M. 3:35 P.M.
Bottom Dropped A.M. 3:45 P.M.

Shutdown Time 180 (Number of Minutes)
1. 60 Min. Lunch
2. 120 Min.-10 Stoppages
3. 10 to 15 Min. each
4. waiting for
5. pneumatics

Total Shutdown Time 180 Min.
Hours of Operation 16:50
Net Hours of Operation 15:50
Melting Rate 13.0 Tons Hr.

Time	Temp.	Chill	B.H.N.
1. 11:30	2740	4	
2. 12:30	2780	3	
3. 1:30	2800	4	
4. 2:30	2790	4	
5. 4:30	2770	5	
6. 5:30	2780	3	Fittings
7. 7:00	2770	4	2 223
8. 8:00	2740	3	1 217
9. 9:00	2760	4	1 207
10. 10:00	2750	3	0 207
11. 11:00	2770	3	1 207
12. 12:00	2770	3	0 207
13. 1:00	2750	4	2 217
14. 2:00	2780	4	1 217
15. 3:00	2760	3	0 207

SPOUT ADDITIONS 285 lbs. Si-Mn-Zr. Inoculant
LADLE ADDITIONS 570 lbs. Ferro-Silicon 50% Si to all Fitting System ladles

CHEMICAL ANALYSIS	T.C.	C.C.	Si.	Mn.	P.	S.
ANALYSIS OF CHG.	3.37		2.62	.73	.43	.11
MELTING LOSS/GAIN			-.28	-.11	--	deaml.
ESTIMATED ANALYSIS	3.37		2.36	.62	.43	.11
ACTUAL ANALYSIS	3.39		2.41	.62	.44	.11

PHYSICAL ANALYSIS
B.H.N. 207
B.H.N. SECT. 3/4 "
TENSILE STR. (P.S.I.) 24,000
Fitting System

CARBON EQUIVALENT (CE) 4.25
EUTECTIC CARBON (EC) 3.44
SATURATION DEGREE CARBON (Sc) 1.02
MANGANESE EQUIVALENT (MnE) .54

REMARKS: 24 ton canister used to line cupola and ladles.
350 lbs. Nodu-Iron used in charges, and 343 lbs. used for desulphurization

PACIFIC CAST IRON PIPE AND FITTING COMPANY SOUTH GATE, CALIFORNIA FORM L3

Fig. 5 . . Overall report holds basic information for quality control.

means of a ladle addition. This allows a higher carbon content to be dissolved and held in the iron lattice structure for a given amount of silicon. Furthermore, such late addition to the ladle of properly sized ferro-silicon contributes to the iron the benefits of inoculation as well as enhanced machinability.

Confirmation of the actual metal composition is rendered through chemical analysis. At Pacific Cast Iron Pipe sample chips are taken separately from individual chill specimens, one representing the base iron, the other the higher silicon metal. These are analyzed daily on a routine basis. Samples from pig iron, coke, scrap, problem castings and miscellaneous items are analyzed as they present themselves. All analyses are run against compatible standard samples obtained from the National Bureau of Standards, Washington D.C.

A report of the cupola operation and some of the pertinent controls is rendered daily on cupola record and metal control report as illustrated in Fig. 5. This brings into focus the extent to which some of the detailed controls, which have been discussed, fall into line in the overall pattern of the cupola operation. Furthermore, data in this summary supply basic information for quality control and inventory.

Good control practices imply a system for maintaining and keeping records that dovetail with the operations at hand. A record book can be used in which chemical analyses, pertinent to metal control, are grouped and identified. Such data can be conveniently grouped under an identifying letter or symbol with a series of numbers following. Thus A400 could imply the 400th heat taken from the A cupola and B400 the same for the B cupola. A series for coke could start with C, purchased scrap SC, cupola slag SL, miscellaneous items M.

There should be a description column in which cross reference is made to a car number or some other clarifying data. The following lists, by way of example, column headings in the record book under pig iron (P series), to which appropriate space have been assigned: identification number, date, description, T.C., C.C., Si., Mn., P., S., blank, remarks.

A similar book can be developed for the physical properties of the metal. Storage for physical specimens should be available. A shallow wooden box with 32 nooks can serve for a months supply of chill specimens. Days of the month can be stamped on each nook and if daily samples are kept in order, the chill specimen for any hour in the day is available for a month. Facilities for tensile, Bhn and other test coupons can be established.

Typical scrap castings or part of such castings should be stored with a proper tag, bearing a brief description. Identification symbols on such piece of scrap should be crossfiled with the revelant chemical and physical properties, production, molding and sand records. In addition a distinct category should be maintained in the physical properties record book, or in a separate book, devoting a specific series to the history of each such typical scrap casting. Some such castings will have relatively brief information, because the problems they have posed were readily solved. However, there will be some, that will present a long and running history of scrap until the stubborn roots of their contrariness can be successfully eliminated.

The methods and principles of control described in this paper, have found practical application at Pacific Cast Iron Pipe and Fitting Co. It goes without saying, that for any controls to be successful, they must be suited to and must fulfill the demands of the specific operation and plant they are established to serve.

AFS Publishes Pollution Book, Working on Others

■ One AFS technical book has been recently published and two more will be ready for distribution in the near future.

Air pollution, its causes and recommendations for control, is covered in *"Foundry Air Pollution Control Manual"*, recently published. This book was compiled by the Air Pollution Control Committee of the AFS safety, hygiene and air pollution program.

It contains 55 pages and is illustrated with photographs, diagrammatic sketches, drawings, charts and graphs. Also included are tables on air pollution characteristics of foundry operation, furnace gases, filter performances, collector selections for foundry operations and scales for grading smoke density.

The manual is composed of eight chapters. Introduction, statement of the problem, review of existing ordinances, community relations, meteorology and typography, atmospheric sampling and analysis, air cleaning equipment, and operating method improvements and equipment maintenance.

"Recommended Good Safety Practices for the Protection of Workers in Foundries" has been revised and expanded and will be published soon.

A completely revised *"Cast Metals Handbook"* is scheduled for distribution in March.

The following members of the AFS Air Pollution Control Committee prepared the material in the publication: Chairman, F. A. Patty, General Motors Corp.; Vice-Chairman, J. C. Radcliffe, Ford Motor Co., alternate, G. L. Burnside, Ford Motor Co.; E. M. Adams, Ph.D., Dow Chemical Co.; Lester V. Cralley, Ph.D., Aluminum Co. of America; Richard B. Engdahl, Battelle Memorial Institute, alternate, N. H. Keyser, Battelle Memorial Institute; David E. Gilchrist, Deere & Co.; John M. Kane, American Air Filter Co.; J. P. Moehing, Jr., Stroman Furnace & Engineering Co.; R. H. Mooney, Central Foundry Div., GMC; Garnet P. Phillips, International Harvester Co.; Robert Pring, Wheelabrator Corp., alternate, George W. Roper, Wheelabrator Corp.; R. J. Ruff, Catalytic Combustion Corp.; Kenneth M. Smith, Caterpillar Tractor Co.; and Herbert J. Weber, Director Safety, Hygiene & Air Pollution Control Program, AFS.

Pre-publication orders for the 1956 TRANSACTIONS, Vol. 64, have been shipped. Copies are now available at post-publication prices.

for President
H. W. Dietert

for Vice-President
L. H. Durdin

THREE STEPS TOWARD CINCINNATI

and the 61st AFS Castings Congress

1 – Announce Candidates for AFS Offices
2 – Advance Registration Starts
3 – Technical Papers Announced

The American Foundrymen's Society has taken three big steps on the road that leads to Cincinnati and the 61st AFS Castings Congress and the First Engineered Castings Show. These events will be held at the Cincinnati Music Hall, May 6-10.

The three big steps are: nomination of candidates for election to office at the AFS Annual Meeting, opening of advance registration for the Castings Congress, and announcement of a tentative list of technical papers for presentation during the congress.

Nominees

■ **Harry W. Dietert,** chairman of the board, H. W. Dietert Co., Detroit, has been nominated to succeed the present president, Frank W. Shipley, foundry manager, Caterpillar Tractor Co., Peoria, Ill. The Nominating Committee of AFS, meeting in Chicago December 10, made the selection.

Mr. Dietert founded his company in 1925 and has authored numerous articles and papers since delivering his first paper to AFS in 1923. Dietert presented the Hoyt Memorial Lecture at the 1954 AFS Congress and the official AFS exchange paper to the 1956 International Foundry Congress in Dusseldorf, Germany.

■ **L. H. Durdin,** president, Dixie Bronze Co., Birmingham, Ala. has been nominated as vice-president. Durdin was elected a Director of AFS in 1954 for a three-year term. He was born in Chicago and graduated from the University of Illinois in 1929 and from Babson Institute, Boston, in 1930. In addition to AFS activities, Mr. Durdin is a past-president of Non-Ferrous Founders' Society and a member of A.I.S.E.

The six men nominated to serve as national directors for three-year terms are:

■ Henry G. Stenberg, foundry superintendent, Draper Corp., Hopedale, Mass., representing Gray Iron and Brass and Bronze. (Chapter Group A—New England Chapter). Mr. Stenberg is a founder of the AFS New England Chapter.

■ A. A. Hochrein, district manager, American Smelting & Refining Co., Baltimore, Md., representing Supplies. (Chapter Group B—Chesapeake Chapter). Mr. Hochrein served as chairman of the Chesapeake Chapter in 1950.

■ Wm. D. Dunn, assistant to the president, Oberdorfer Foundries, Inc., Syracuse, N.Y., representing Brass and Bronze. (Chapter Group C—Western New York Chapter). Mr. Dunn has been an AFS member since 1927 and served as chairman of the Central New York Chapter.

■ Fred J. Pfarr, manager, Lake City Malleable Co., Cleveland, representing Malleable Iron. (Chapter Group F—Northeastern Ohio Chapter). Mr. Pfarr is a past president of the Northeastern Ohio Chapter.

■ Karl L. Landgrebe, Jr., vice-president, foundry operations, The Wheland Co., Chattanooga, Tenn., representing Gray Iron. (Chapter Group O—Tennessee Chapter). Mr. Landgrebe is a founder of the Tennessee Chapter and served as chairman 1949-50.

■ John R. Russo, president, Russo Foundry Equipment Co., Oakland, Calif., representing Equipment. (Chapter Group Q—Northern California). Mr. Russo served as Northern California Chapter President, 1950-51.

Registration

Everyone planning to attend the 61st Castings Congress is offered an opportunity to register in advance by using the convenient form on page 85-86 in this issue of Modern Castings. Advance registration offer is good only until April 15.

Continued on page 85

Wm. D. Dunn

A. A. Hochrein

K. L. Landgrebe

Fred J. Pfarr

John R. Russo

Henry G. Stenberg

COST-CUTTING WITH GRINDING WHEELS: PART 1

SNAGGING WHEEL SPEED CONTROL

Control of surface speed is first step in planning snagging operations that will remove metal, faster, at lower cost

JOHN A. MUELLER /
The Carborundum Company
Niagara Falls, N. Y.

John Mueller is manager of the grinding laboratory for the bonded abrasives division of the Carborundum Company. In his research capacity, he has conducted extensive original research on the factors that control the costs of grinding operations. Now for the benefit of the readers of MODERN CASTINGS, *he has summarized his studies on reducing the costs of the principal foundry grinding problems: snagging and cut-off. Mr. Mueller's work will be presented in a series of four articles of which this is the first. In the articles to follow, Mr. Mueller will describe how to reduce snagging costs by wheel work pressure control and proper wheel selection. He will then turn to the subject of cut-off for two articles that will cover the reduction of cut-off costs by wheel speed control and by proper wheel selection.*

Grinding wheels are basic tools in the foundry industry and the cost of wheels and grinding operations is a primary part of the sale price of a casting. The foundryman who wants to follow some sound, cost-cutting advice on the use of grinding wheels is certainly going to gain a competitive advantage.

Such profitable advice is now available as a result of extensive researches in our laboratories.

The most recent figures available from the United States Bureau of the Census show that the foundry industry spends over $27 million each year on abrasive products. A large share of this goes for snagging wheels and abrasive cut-off wheels so the advice to be presented in this series of articles is fundamentally a description of how the foundry industry can make the most profitable use of its great investment in these items.

To determine the maximum efficiency of snagging and cut-off operations, we have designed and built grinders that operate automatically and are independent of the operator and individual technique.

This equipment was designed to control the two variable factors that comprise a grinding operation: the operating conditions under which the wheel is run, and the abrasive wheel itself.

Operating conditions for the use of abrasive wheels are:

Speed—as the wheel wears from full size to stub size the surface speed of the wheels changes.

Pressure—the pressure with which the work is applied to the wheel.

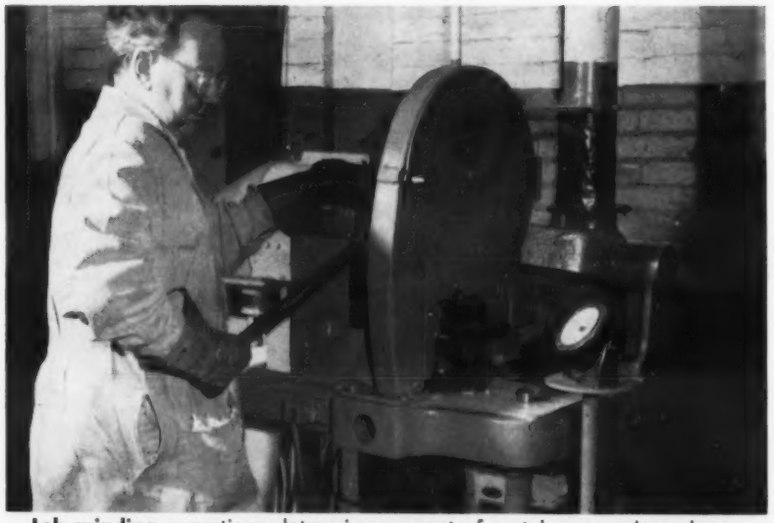
Capacity—the capacity of machine required for the operation determines the amount of power that will be used.

Grinding wheels may vary in open or dense wheel structure, grit size, type of grain, and wheel grade.

Lab Does Groundwork

By building automatic testing machinery to remove the influence of any particular operator's technique, the operating conditions under which the wheel is operated are brought under precise control.

The hydraulically operated grinders reproduce as nearly as possible the motions that a man performs while grinding on a swing



Lab grinding operations determine amount of metal removed per hour, grinding efficiency, wheel life, and consumption of electric power.

Hydraulically operated automatic grinders duplicate the motions of a human operator but eliminate the factor of individual technique.

frame grinder or at a stand grinder. There is an angular motion in a horizontal plane, angular motion in a vertical plane, traverse motion across the metal, and infeed motion against the metal. The degree of movement in each motion can be varied over a wide range and in such a way that they are completely out of phase at all times.

To measure the effect of the wheel itself, the production rate for the wheel is determined in terms of the amount of metal removed per hour, the consumption of electric power is measured with a wattmeter, and the wheel performance is measured in terms of grinding efficiency and wheel life.

The results that come from these laboratory machines are verified in actual field operations before any use is made of the data, of course.

From the investigation we have drawn some conclusions that clearly indicate changes that the foundryman can make to substantially reduce grinding costs.

In discussing the conclusions that we have reached and the steps that the foundryman can take, I will first discuss snagging operations and then cut-off. The first phase of the discussion will be speed control for snagging wheels. In succeeding issues we will discuss wheel selection for snagging speed control for cut-off, and wheel selection for cut-off. Each of these topics represents an opportunity for reducing the costs of grinding operations in the foundry.

Start With Speed

Every program must have a beginning and our studies show that a cost reduction program for snagging operations should start with maintaining a constant wheel *surface* speed. This means that the wheel speed in rpm must be increased as the wheel wears down. The study also shows that the wheel should be operated at speeds as high as are consistent with the American Standards Association safety code for abrasive wheels (ASAB7.1-1.).

The general effect on wheel performance as the wheel wears from full size to stub size is that it acts softer. This is well known in the trade and is nothing new. The magnitude of this effect and how it influences the cost of grinding may not be so well known.

Maintaining constant speed will produce: faster metal removal rates, increased wheel efficiency, full utilization of available power, the same production with fewer machines, and a lower bill for electrical energy.

The proof of these statements may be found in the curves that illustrate our test results.

Figure 1 shows the cutting rate, the pounds of metal ground per hour, as a function of wheel diameter. From this graph it is evident that by running the wheel at the same rpm throughout its life a substantial loss in production occurs. When the wheel was worn from a diameter of 24 in. to 18 in. a 37 per cent loss in cutting rate occurred. It is also apparent that this loss in cutting rate began to occur in the first inch of wheel wear. One inch of wheel wear resulted in a production loss of 11 per cent.

This 37 per cent loss in cutting rate was reduced to 15 per cent simply by changing the wheel rpm to maintain a constant speed in surface feet per minute (sfpm) throughout the wheel life. The loss that occurred, on Fig. 1, at constant speed is due to the change in the arc of contact and cannot be recovered. However, by keeping wheel speed constant, the loss in production rate can be reduced and grinding losses can be kept to a minimum.

Figure 2 shows the power that was consumed by the wheel as it ground from full size to a smaller size. When the wheel rpm was not changed, production rate dropped off 37 per cent and power consumption was decreased 20 per cent. This means that the grinder was operating at only 80 per cent of full capacity and it further means that it required five machines to do what four machines could do if they were operating at full capacity. Consequently one machine and one operator and all the attendant production was lost.

Figure 3 shows the electrical energy that was consumed during grinding. This graph shows that when the grinding wheel was operated at constant speed it took less horsepower to remove a pound of metal per hour than when the wheel was operated at constant rpm. This means that more effective use was made of the available electrical energy and it therefore represents a saving in the electrical bill each month.

The next factor in the grinding process is the wheel and Fig. 4 illustrates the grinding ratio—the metal removed for each unit of wheel loss—as the wheel wears away. Figure 4 shows that the wheel was more efficient at constant speed than at constant rpm. The abrasive was used more effectively and therefore the cost of abrasive to remove metal was decreased. The amout of metal the wheel would remove at constant speed could be expected to be about 20 per cent more than if the wheel was run at constant rpm.

You Have To Be Fast

The speed at which the wheel is operated must be constant, but it must also be the highest speed possible.

In any discussion on wheel speed it is absolutely imperative to stress the fact that wheel speeds must at all times conform to the practices set forth by the American Standard Association safety code. Strict con-

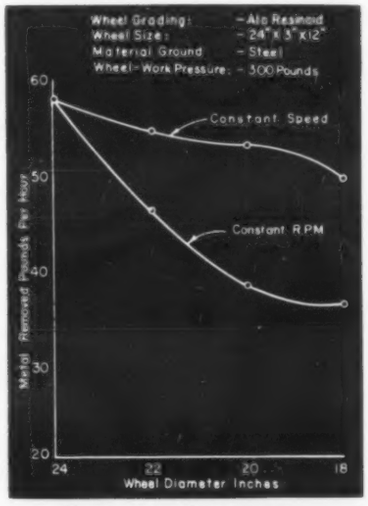


Fig. 1 . . Production rate.

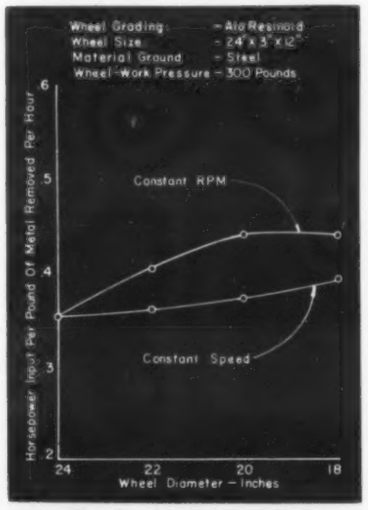


Fig. 2 . . Use of capacity.

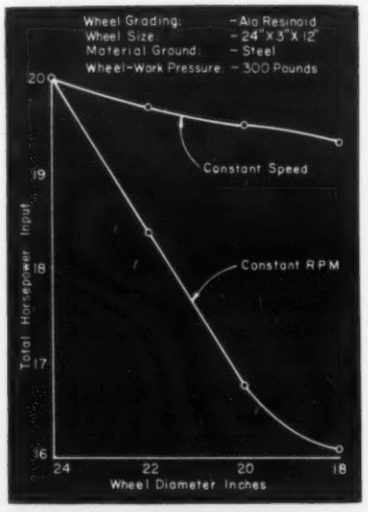


Fig. 3 . . Power consumption.

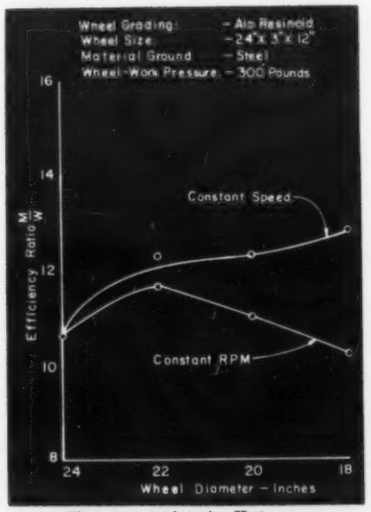


Fig. 4 . . Wheel efficiency.

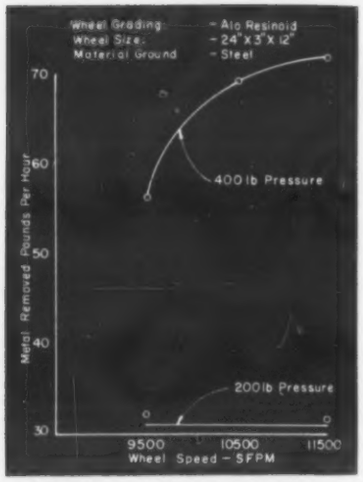


Fig. 5 . . Metal removal rate.

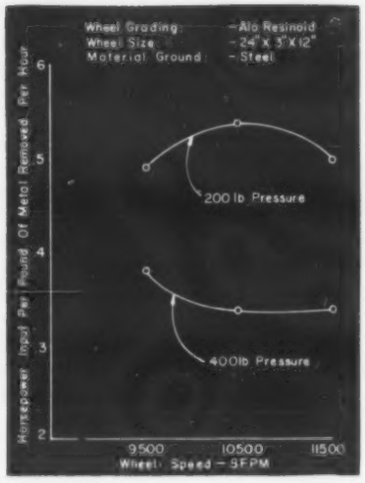


Fig. 7 . . Speed and power (2).

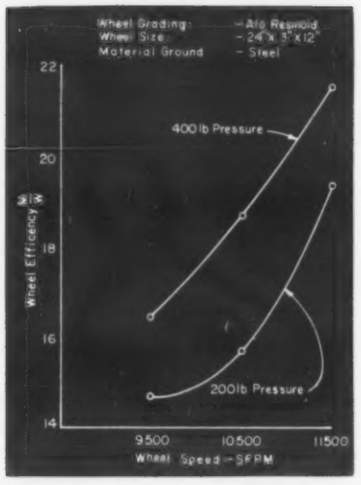


Fig. 8 . . Speed and efficiency.

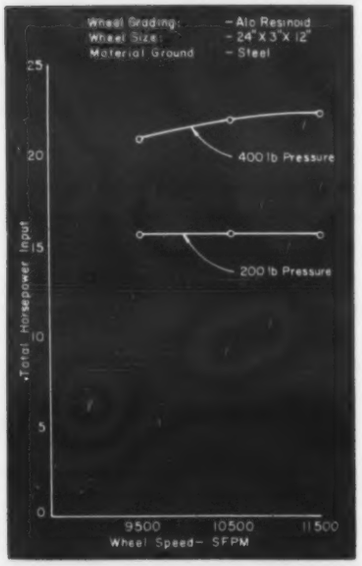


Fig. 6 . . Speed and power (1).

formance to this code has historically proved to be the only efficient and safe manner in which to use grinding wheels. Strict adherence to the code will protect the operators from injury and will provide maximum insurance for the entire plant from any accidents. It must be pointed out that grinding wheels operate at a speed of 2 to 3 miles per minute. This means 120 to 180 miles per hour and at that speed due caution must be exercised at all times.

In order, however, to promote a better understanding of the effect of wheel speed on wheel performance the following data were developed.

Figure 5 shows the effect of metal removal rate at various wheel speeds. This graph shows a very remarkable relationship between wheel-work pressure and wheel speed. When a light pressure was applied to the wheel no beneficial effect occurred with an increase in wheel speed. However, at a heavier wheel-work pressure an increase of 1000 sfpm produced a 23 per cent increase in metal removal rate. A further increase of wheel speed of 1000 sfpm produced only an additional 5 per cent increase in metal removal rate. Wheel speed and wheel-work pressure are clearly related and no universal treatment can be applied generally to the snagging industry. These data indicate that each operation must be considered individually before any beneficial effect can be produced by changing wheel speed.

Figures 6 and 7 show the power consumption as related to wheel speed. It is evident that the higher metal removal rates consume more power. Figure 6 shows that at heavy wheel-work pressures, less power per unit of metal removed is consumed at higher speeds than at lower speeds. This indicates that higher speeds make more effective use of the available power.

Figure 8 shows the wheel efficiency as a function of wheel speed. It is obvious that the efficiency of the wheel increases as the wheel speed is increased. At both the light and the heavy wheel-work pressure an increase of wheel speed from 9500 sfpm to 11,500 sfpm produced a 30 per cent increase in wheel efficiency.

How To Control Speed

Adjustments in wheel speed to compensate for wheel wear are accomplished by using grinders that are designed for that purpose. Two types of grinders are generally available. The first type has an infinite speed variation, the other, more commonly used type, has a three or four speed spindle with an interlocking arrangement to prevent over-speeding the grinding wheels.

The infinite variable speed grinder is able to compensate for minute changes in wheel speed. This is accomplished by using an infinite variable mechanical drive.

The multi-speed spindle compensates for definite increments of change in wheel speed. The manner in which this works is, simply, when the wheel has worn down a predetermined amount, the wheel speed is increased. To increase wheel speed, the belt tension is released and the cone sheave on the grinding spindle is adjusted to the next position, and tension is then replaced on the belt.

These machines are so designed that the wheel guard can be adjusted to compensate for wheel wear and full diameter wheels cannot be mounted until the slow speed drive is positioned.

Instructor's Seminar Set for June 20-22 at M.S.U.

■ Foundry instructors will meet June 20-22 at Kellogg Center, Michigan State University, East Lansing, Mich., for the 2nd Annual AFS Foundry Instructor's Seminar. More than 100 persons attended the first seminar held last year at Michigan State.

A tentative program has been prepared which will include an inspection trip, demonstrations and lectures.

Activities will start Thursday, June 20 with registration at 8:30 am. This will be followed by welcoming speeches and introductions. New developments in the casting industry will be covered as well as the AFS Training Institute.

Following lunch, the Robert E. Kennedy Memorial Apprentice Contest will be discussed. Other afternoon activities will be a report on foundry manpower needs, in-plant training discussions, major points for coordinating the school-industry program and an inspection trip.

Friday's program begins with a discussion on industrial arts and cast metals. Other topics are industrial arts guide for cast metals instruction and what small and large industries expect from the teacher. At the noon luncheon session "The American Engineer" will be shown. The remainder of the afternoon will be devoted to workshops. Activities will conclude with a dinner session and a speaker.

Starting Saturday's program will be a talk on foundry safe practices, demonstration aids, texts and course materials a resume of the seminar and a luncheon. An open house will be held at the Michigan State foundry in the afternoon.

New Zinc-Base Standards

Six new spectrographic standard samples of zinc-base alloys are available from the National Bureau of Standards. Analyzed and certified as to composition, the new standards are designed for calibrating and checking spectrochemical methods in the analysis of two important zinc-base die-casting alloys (A.S.T.M. designations AG40A and AC41A).

For each of the alloys, three standards have been issued to provide the necessary composition ranges for the elements covered by specifications; aluminum, copper, magnesium, iron, lead, cadmimum and tin. The standards also contain useful concentration ranges for chromium, manganese, nickel and silicon.

$300\MAN AIR CONDITIONS FOUNDRY HOT SPOTS

Summer production slow-down eliminated at Woodruff & Edwards, Inc., with an unusual air conditioning system

GEORGE P. EDWARDS / *President and* ROY SWAIN / *Director of Purchases*
Woodruff & Edwards, Inc., Elgin, Ill.

Cool air pours down from this duct at 20 stations on the molding line.

Soaring summer temperatures no longer signal lowered morale and enthusiasm for men handling hot sand and castings at Woodruff and Edwards, Inc., Elgin, Illinois. The successful installation of a unique system of localized air conditioning in our plant has made it possible to provide comfortable conditions at 38 work stations where summer temperatures become very hot. The investment required to make this beneficial improvement in working conditions was $300 per worker.

This localized system is not air conditioning in the conventional concept, where the entire room is brought to a comfortable working temperature. Instead, the immediate environment around the individual worker is made comfortable by flowing dehumidified and cooled air from an overhead diffuser.

Each man can control the volume and pattern of air flow on him by adjusting the baffle located above his working area. Such an installation is only practical where men are working at a fixed station and do not move about too much.

There were three spots in our plant that lent themselves to this type installation: the jolt-squeeze production line, the sorting of castings after cleaning, and the snagging operation. In these operations the men are working at fixed positions, and working environment was hot enough to seriously reduce the summer production rate.

Much of the heat in these areas comes from the re-use of sand on the mechanized molding line. The sand is used as often as three and four times a day and its temperature builds up to over 120 F. Further heat is present because we shake out and clean our castings as soon after pouring as possible.

Castings coming from the automatic cleaner are at times too hot to touch with bare hands. These hot castings are conveyed past two sorting stations which are now air conditioned so that the operators handle these hot castings while they stand in a stream of comfortable, tempered air.

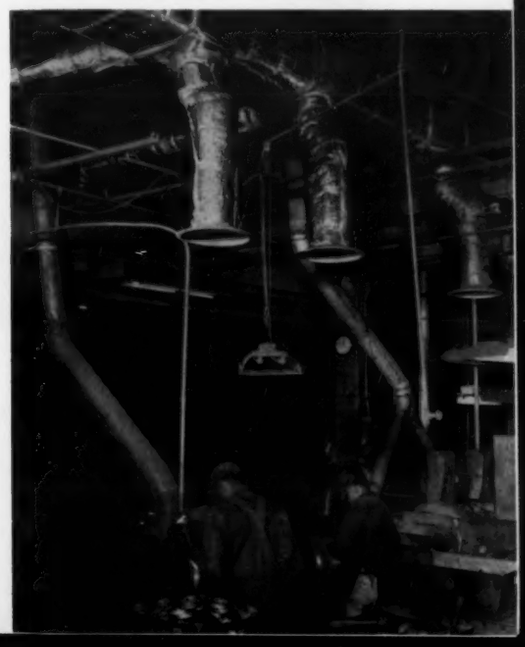
From the sorting stations, the castings are moved in tote boxes to a snagging wheel station. The tote boxes are moved as soon as they are full, so the castings arrive at the snaggers at a temperature of over 120 F. Here the men are able to handle hot castings while they stand in the cool air bath.

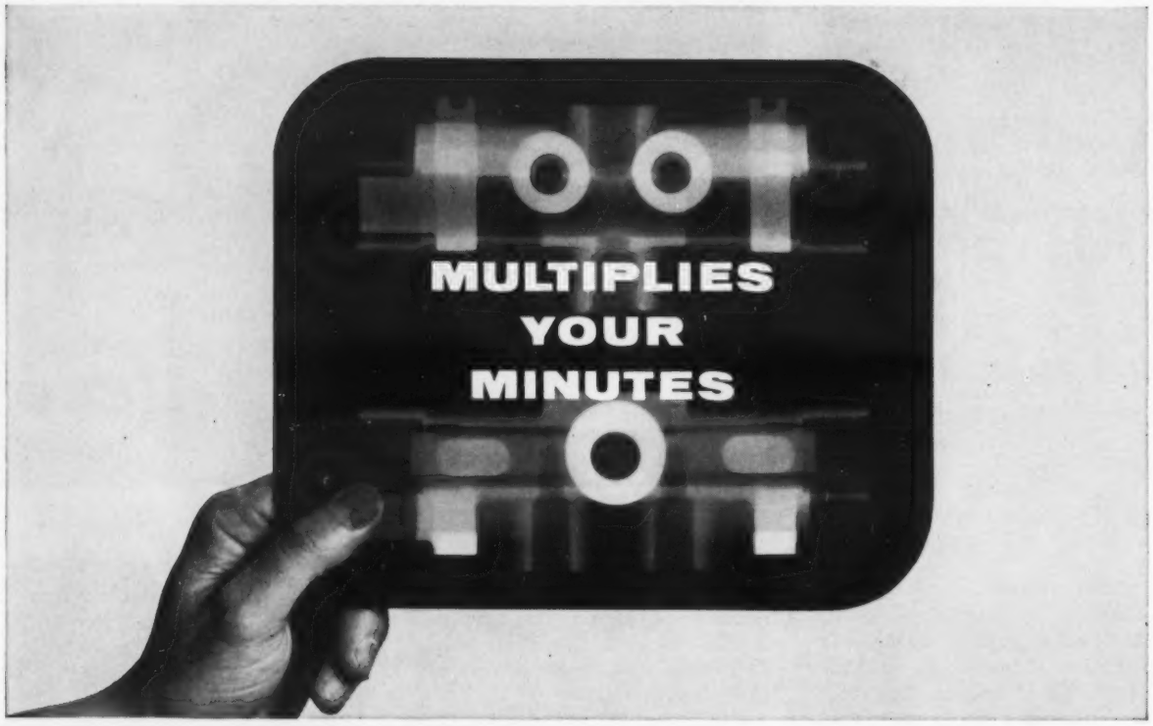
Once convinced that something should be done about our heat problem, we consulted an experienced industrial air-conditioning firm in Elgin which came up with our unique installation.

In the machine molding room and in the grinding room 15-ton, water-cooled, commercial air-conditioning units were installed on platforms above all other interfering cranes, conveyors, and piping. Each unit brings in fresh air from the outside through a filter at the rate of 6000 cu ft per min. The humidity of the outside air is reduced 50 per cent and its tempera-

Too hot to touch, yet these castings are being sorted by men who work in cool comfort. Plant has 38 air conditioned work stations.

Snaggers at 16 stations are bathed in flow of cooled, dehumidified air.





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Kodak

CIRCLE NO. 112, PAGE 21-22

ture is lowered 10 F before it reaches the worker.

The treated air moves through a main distribution duct running above the working area. The main duct has a cross section of 20 by 16 in. and is 150 ft long in the molding room. The grinding room duct measures 30 by 16 in. by 170 ft. These ducts are wrapped with aluminum-backed fibreglass insulation.

The optimum height from which to diffuse the air onto the workers was selected as 10½ ft above floor level. Vertical ducts come down to this level from the main duct at each work station in the grinding room.

Since the main duct in the molding room was already at the proper height it was only necessary to make openings in the duct over the stations. The cooled and dehumidified air is not blown down, but literally falls down around the man so there are no objectionable drafts.

The molding room system serves 20 stations in the mechanized molding line while the other system handles 2 casting-sorting stations and 16 snagging wheel operations.

Each of the two installations cost about $6000. In each unit there are three 5 hp motors for the compressor and one 2 hp motor for the fan. With electricity costing the plant 1½ cents per kw-hr, each unit consumes 22½ cents of power per hour. According to Pat Blake, air-conditioning engineer who designed the job, he has not had a service call since the installation was made in June, 1956.

Woodruff & Edwards is a jobbing foundry producing ferrous and non-ferrous castings weighing from one ounce to one ton. The 300 employees in our foundry are now producing about 20,000 tons of gray iron and about 1000 tons of non-ferrous castings annually. Our management is convinced that the money spent on the air conditioning system was well spent in terms of improved working conditions; morale has gone up and absenteeism on hot days has been virtually eliminated. Since the men are on piecework, increased production has been of mutual benefit to both employee and employer.

Investment Casters Hear Vacuum Processes Talks

■ Over 150 members and guests of the Investment Casting Institute met in Detroit, November 13-16, to participate in a program designed to keep them abreast of the rapidly changing technology of precision casting.

A feature of the program was the day devoted to a special Vacuum Metals Symposium. Under the chairmanship of Dr. Jack Keverian, manager, applied research & development, Foundry Dept., General Electric Co., the symposium covered the field of vacuum melting and casting through talks by top men in the field.

Dr. N. J. Grant, M.I.T. professor of metallurgy, reviewed past experiences with vacuum melting and casting. "The Influence of Vacuum on Properties of Various Materials" was reviewed in a paper by A. J. Kiesler and W. F. Moore, General Electric Co. The speaker emphasized the importance of melting in vacuum those alloys high in titanium.

The equipment and operational problems associated with vacuum melting and casting were described by J. H. Moore, general manager, Vacuum Metals Division of Crucible Steel Corp. Speaking about refractories and molding materials for vacuum casting, H. O. McIntire, asst. chief, Metallurgical Engineering, Battelle Memorial Institute, compared the behavior of various refractories in contact with molten metal in vacuum.

Vacuum melting must be technologically possible and economically profitable for industrial application, according to Dr. F. N. Darmara, manager, Metals Division, Utica Drop Forge and Tool Co., in his talk on the economics of vacuum melting and casting.

Prof. H. F. Taylor, Department of Metallurgy, M.I.T., summarized the proceedings of the symposium. He felt that each operator must determine to his own satisfaction "whether the cost of vacuum melting and casting will pay the freight."

The first two days of the Fourth Annual Meeting of the ICI was devoted to meetings of committees, business sessions, and election of officers. The new president is K. W. Thompson, K. W. Thompson Tool Co., New Hyde Park, N. Y. Other officers elected were vice president, P. W. Schipper, Howard Foundry Co., Milwaukee; treasurer, V. S. Lazzara, Casting Engineers, Inc., Chicago; and directors, C. R. Whittemore, Deloro Smelting & Refining Co., Deloro, Ontario, R. C. Kramer, Kolcast Industries, Inc.,

Continued on page 68

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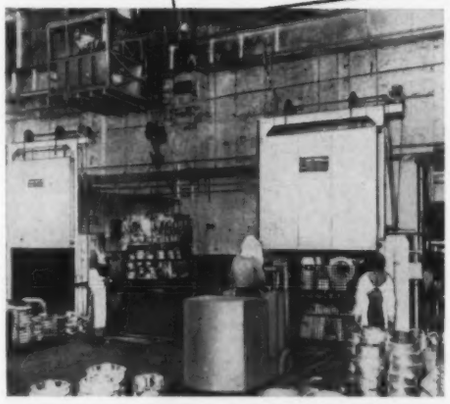

Rack type ovens for ageing (left) and solution heat treat (right) of aluminum alloy castings.

Car type annealing furnace for steel castings, over-and-under-fired, features induced circulation of gases for temperature uniformity.

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Write for Bulletin 56-T.

Magnesium aircraft castings are solution heat treated in Coleman rack type SO_2 atmosphere ovens.

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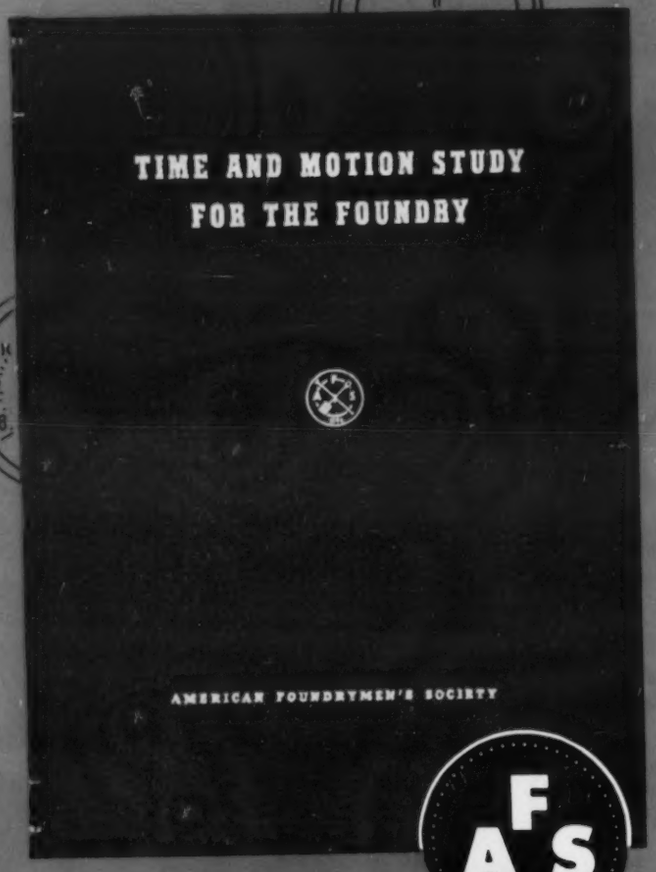
CIRCLE NO. 141, PAGE 7-8

How and how long?



Answers to these basic questions provide the fundamental ingredients for sound management planning:

- . . . detailing the project
- . . . performing the operation
- . . . controlling the costs

Motion Study is nothing more than determination of the preferable way of doing work. *Time Study* is nothing more than appraisal of the work involving human effort.

The combined techniques are explained and developed in TIME AND MOTION STUDY FOR THE FOUNDRY, a symposium of carefully selected articles that provide practical foundrymen with information on:

- savings in labor
- savings in time
- reduction in costs
- increased marginal profit

Every article is developed on the principle that "a straight line is the shortest route between two points." Consequently, every article is of vital help to foundry management.

TIME AND MOTION STUDY FOR THE FOUNDRY is a casebound, 8½ x 11-inch book, totaling over 165 pages. It includes 24 separate papers, prepared by authorities in their respective fields of activity—it is replete with hundreds of descriptive photographs tables and charts.

AFS

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Continued from page 67

Cleveland, and V. S. Lazzara.

The Institute paid tribute to six of its outstanding members by presenting them with distinguished service awards for their contributions to the welfare and progress of the Investment Casting Institute and the investment casting industry. The awards were presented by V. S. Lazzara, retiring ICI president, to K. M. Bartlett, exec. vice-pres. of Horizons Inc., Cleveland; Dr. N. J. Grant, Prof. of Metallurgy, M.I.T.; Roger Waindle, president, Wai Met Alloys Co., Detroit; T. Operhall, president, Misco Precision Castings Co., Whitehall, Mich.; E. G. Chapman, Misco Precision Castings Co.; and Dr. R. A. Flinn, Prof. of Metallurgy, University of Michigan.

Common Hazards Account for ⅓ of Foundry Fires

Common hazards accounted for 32 per cent of foundry fires, according to an analysis of 450 foundry fires by the National Fire Protection Association. The analysis is carried in the American Foundrymen's Society manual, "Recommended Safe Practices for the Protection of Workers in Foundries" soon to be published. Special hazards accounted for 59 per cent of fires and the remaining were attributed to unknown causes.

COMMON HAZARDS	PER CENT
Cutting and welding	05.3
Eletcrical appliances	04.9
Spontaneous ignition	04.2
Careless disposal of smoking materials	04.0
Exposure	03.8
Heating equipment	03.3
Miscellaneous	02.4
Electrical fixed services	02.0
Lightning	01.1
Incendiary	0.7
Explosion	0.4
Total	32.1
SPECIAL HAZARDS	
Cupolas	20.4
Melting furnaces	09.8
Molten metal	09.1
Core ovens	06.9
Blowers and exhaust fans	03.3
Miscellaneous	02.9
Quenching	02.0
Die casting (hydraulic oil ignition)	02.0
Flammable liquids	01.6
Grinding and buffing	01.3
Total	59.3
UNKNOWN CAUSES	08.6
Total	100.00

foundry trade news

General Electric Co. . . the Chemical and Metallurgical Division of GE had the highest sales level in its history in 1956. The organization states that it expects to project current growth into 1957 and beyond by increasing research and development activities. Headquartered at Pittsfield, Mass., the division operates 11 plants in six states.

Iron and steel scrap was generated and consumed at about the same tonnage levels in 1956 as in 1955 despite the July steel strike. Over 41 million gross tons, consisting of about 36 million tons of purchased scrap for domestic foundries and mills and 5 million tons for export passed through dealers and brokers, an increase of about 2 million tons over 1955.

Electromet . . Price increases of some manganese and silicon alloys and of all nickel-bearing alloys have been announced by Electro Metallurgical Company, division of Union Carbide and Carbon Corp. Higher production costs were stated as the reason for increases.

King Foundries Inc. . . a fire burned out the interior of the main foundry building at North Wales, Pa., December 12. Damage to the 125,000 sq ft building was estimated at $100,000.

Arwood Precision Casting Corp. . . New York firm has announced the distribution of $246,432 to 650 employees under its profit sharing plan of operation. Arwood operates investment casting foundries in Brooklyn, N. Y.; Groton, Conn.; Tilton, N. H.; and Los Angeles, Calif.

American Brake Shoe Co. . . has combined four of its railroad equipment operations into a new railroad products division. Headquarters will be in New York. Included in the new organization are the railroad products facilities of the present Brake Shoe & Castings division, National Bearing division, Ramapo Ajax division, and the Southern Wheel division.

Soo Foundry and Machine Co., Ltd. . . Sault Ste. Marie, Ont., firm has joined the American Foundrymen's Society. Plant produces gray iron, aluminum, and brass and bronze castings.

American Die Casting Institute . . has announced that the recent acceptance of eight new members raises its total membership to 118 companies.

Kastalloy Co., Inc. . . Rogersville, Mo., firm has joined Non-Ferrous Founders' Society.

Pennsylvania Malleable Iron Corp. . . expects full operations to start in its new plant at Landisville, Pa., about April 1. The new, $600,000 plant will supplement production of the present operations at Lancaster, Pa.

Bushwick Brass Foundry, Inc. . . Brooklyn, N. Y., firm has joined Non-Ferrous Founders' Society.

Ohio Ferro-Alloys Corp. . . will build a new ferro alloys plant near Clarington, Ohio. Plant is estimated to cost in excess of $3,000,000 and will have three large electric furnaces.

Imprex Division . . is the new name for Tincher Products Co., Milwaukee, manufacturer of impregnation equipment for pressure castings.

Carborundum Co. . . had 1956 sales of over $100 million. This was the first time in the firm's 65-year history that its sales passed this mark.

Ajax Engineering Corp. . . announces that it will combine engineering, manufacturing, and sales efforts with the Ajax Electric Furnace Corp., Philadelphia. All services will be handled from the office of Ajax Engineering Corp., Trenton 7, N. J.

Torrance Brass Foundry . . Torrance, Calif., firm has joined Non-Ferrous Founders' Society.

Arrow Pattern and Engineering Co. . . Erie, Pa., producer of shell molded castings has joined Non-Ferrous Founders' Society.

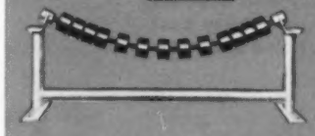
International Nickel Co. of Canada, Ltd. . . has announced a 9½ cent per pound increase in nickel prices. Firm has also announced a new project in Manitoba which will result in a major increase in nickel production.

Federated Metals . . division of American Smelting and Refining Co. will construct a large secondary aluminum smelter at Alton, Ill. Plant will have an annual capacity of 72 million lb of ingot, which will double the firm's present production.

Metal & Thermit . . the new combined office, warehouse and manufacturing facility of Metal & Thermit-United Chromium of Canada, Ltd.,

FORD Foundry uses JOY LIMBEROLLER Belt Conveyor Idlers

Joy Limberollers at work on a belt conveyor at Ford's Cleveland Foundry.



This radical, new idler is used in handling abrasive foundry sands at Ford's Cleveland Foundry. Each idler is a single roller consisting of a series of pressure-molded neoprene or rubber discs on a flexible steel cable. Only two bearings are used and these are up out of the dirt zone.

Joy's new belt conveyor idler has already given over *twelve times* the service life of conventional idlers in handling many difficult materials . . . abrasive foundry sands, coal, petroleum coke, potash, copper ores, mill tailings, iron ore, wet concrete, triple super-phosphate, ammonium sulphate and sticky fertilizers.

The Limberoller is unaffected by most corrosives that damage steel . . . is ideal for chemical, sulphur and salt plants.

Get details from *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 137-70

Consult a Joy Engineer

For Air and Gas Compressors, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors

JOY

Since 1851 . . . Over 100 Years of Engineering Leadership

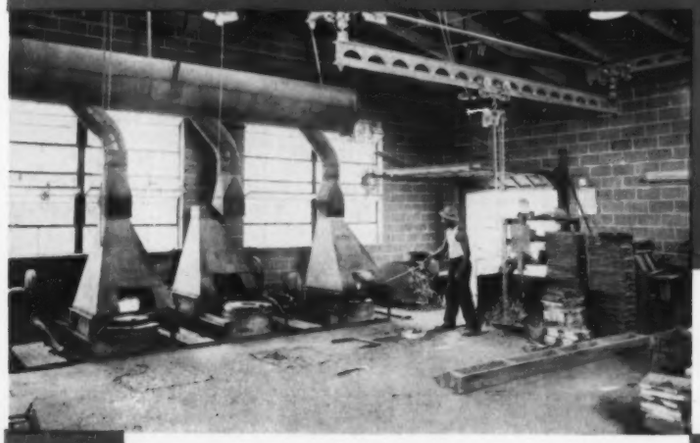
WSW L-6358-137

CIRCLE NO. 114, PAGE 7-8

"ON THE RECORD"

CRUCIBLE Melting

THE MODERN METHOD !



Three of the four oil-fired furnaces with No. 60 Crucibles, in the new quarters of O'Hare Brass & Aluminum Foundry Company of St. Louis, Mo. Crucible capacity 200 lbs. brass or 60 lbs. aluminum. Note roll-back fume hoods and excellent housekeeping.

Crucible melting belongs in the up-to-date, modernized non-ferrous foundry as shown in the illustration of an old-established company moved into new quarters.

Crucible melting completes the picture of overall efficiency and economy required to produce high quality castings in a highly competitive market.

CRUCIBLES FOR FLEXIBILITY

CRUCIBLE MANUFACTURERS ASSOCIATION

Room 2856 11 West 42nd Street, New York 36, N. Y.

THESE FIRMS CAN TAKE CARE OF ALL YOUR REQUIREMENTS FOR CRUCIBLE MELTING

LAVA CRUCIBLE-REFRACTORIES CO.
AMERICAN REFRACTORIES & CRUCIBLE CORPORATION
JOSEPH DIXON CRUCIBLE CO.
VESUVIUS CRUCIBLE CO.
ELECTRO REFRACTORIES & ABRASIVES CO.
ROSS-TACONY CRUCIBLE CO.

CIRCLE NO. 115, PAGE 7-8

has been completed. New building is near Toronto in Etobicoke Township.

Ductile Iron Fdy., Inc. . . . Stratford, Conn., iron foundry has joined the American Foundrymen's Society.

Lindberg Engineering Co. . . . has opened a new sales office at 146 University Ave., Rochester 5, N. Y.

Brown Fintube Co. . . . Elyria, Ohio, firm has formed a subsidiary known as Brown Thermal Development Co. to produce and develop heat transfer equipment for waste heat recovery and recuperation.

Minnesota Mining & Mfg. Co. . . . will distribute the barrel finishing equipment manufactured by Speed-D-Burr Corp., Glendale, Calif.

American Blower Corp. . . . is celebrating its 75th year. Company has received wide publicity in its hometown, Dearborn, Mich.

American Metaseal Mfg. Corp. . . . has been issued a patent for processes for impregnating castings with water-washable polyester resins.

Air Reduction Sales Co. . . . has doubled the capacity of its plant at Butler, Pa.

Great Lakes Carbon Corp. . . . will produce graphite in England in a plant at Newcastle. English plant will be operated by Anglo-Great Lakes Corp., Ltd.

Baker-Raulang Co. . . . has named Shafer Industrial Equipment Co. Omaha, as a dealer for its materials handling trucks and equipment.

Thor Power Tool Co. . . . has new branch offices at Richmond, Va., and Indianapolis, Ind.

Norton Company . . . has officially opened its recently completed electric furnace plant at Huntsville, Ala.

Release New Casting Alloy

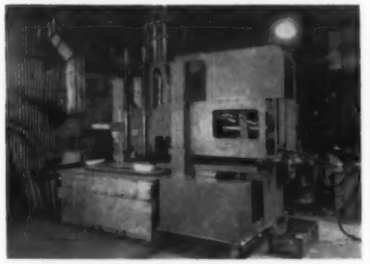
The Aluminum Co. of America has announced a new aluminum casting alloy, XA140, with good casting characteristics and outstanding mechanical properties at 400-600 F. The alloy percentages are 8 Cu, 6 Mg, 0.5 Mn, 0.5 Ni, plus small amounts of iron and titanium for grain refinement and beryllium for oxidation resistance.

Die Casting Machine Makes Aluminum Slugs

■ Pre-cast aluminum slugs for impacting or forging are made automatically at the Stroman Furnace & Engineering Co., Franklin Park, Ill. These are cast with a very close grain to specified dimensions and require no tumbling or deburring.

The process consists of a water-cooled die which incorporates cavities machined to the shape to be cast. Vents are located in the deepest part of the cavity for air removal.

The die sits in a round pan which has gate holes in the bottom. Gates



Water-cooled pan is out of the metal at start of cycle. Blanks have been dropped in tote box at rear of machine.

are also located in the center of each cavity. As the die and pan are submerged below the metal surface, the metal flows through the gate holes into the cavity. As the metal fills the cavity, air is relieved through the vents. The metal at the gate is the last to solidify and the shrinkage takes place at that point.

Solidificaion is controlled by an adjustable timer and averages 12 to 14 seconds for each half inch of diameter. When the cooling cycle ends, the die and pan rise out of the metal and the die is drawn across the pan bottom to shear the solidified gates. The die clears the pan and travels horizontally to a chute where the slugs are ejected.

Multiple as well as individual castings may be made. The dies have a long life since there are no moving parts expect ejector pins when needed.

The machine also makes irregular shapes where all contours taper toward a high point of the casting. The shapes are made to the approximate outline with a specified amount of metal to minimize the forging flash.

Various aluminum alloys have been cast and a future experimental program on other metals will be started soon.

New LINDBERG–FISHER Autoladle

We call it "LITTLE JOE"

Here, for the first time, is a ladling unit that makes automatic casting of aluminum not only possible but practical. The Autoladle has been thoroughly tested and proven in service.

"LITTLE JOE" provides these advantages:

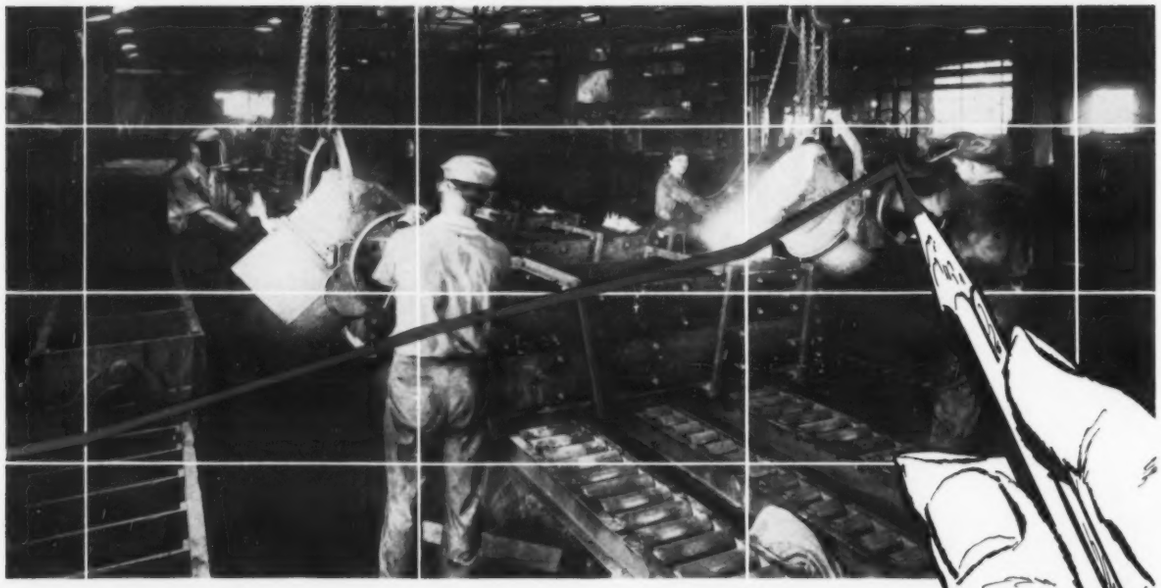
- Adaptable to induction, electric resistance or fuel-fired reverberatory furnaces.
- Ladled metal is withdrawn from beneath surface of bath.
- Precise, accurate control of any size shot up to 30 lbs.
- No interruption of the casting cycle during charging of metal.
- No variation of size of shot due to metal level changes.
- Composed of special refractory materials so arranged that ladled metal cannot come in contact with any metal.

To the best of our knowledge this is the first practical automatic ladling unit yet devised. It will fill an important need in many casting operations. For complete information, get in touch with your nearest Lindberg Field Representative (see your classified phone book) or write direct.

LINDBERG FISHER **MELTING FURNACES**

A Division of Lindberg Engineering Company, 2440 West Hubbard Street, Chicago 12, Illinois

CIRCLE NO. 116, PAGE 7-8



HOW DOES YOUR FOUNDRY GROW?

Through an increasing awareness of cast metals potential; through streamlined production methods; through continued research and new development.

Yes, these are the necessary growth factors. But they all stem from one source . . . sound, technical leaders and pre-indoctrinated customers.

The investment of the foundry industry in the student of today and tomorrow largely determines its potential. We cannot grow as an industry — or as an individual foundry — without soundly indoctrinated foundry technicians.

Through the efforts of the Foundry Educational Foundation, 31% of all engineering students at F.E.F. affiliated universities now participate in cast metals study. This means a large annual pool of capable producers for the foundry industry.

What are you contributing to that pool today, for your greater benefit tomorrow?

● *Write today for our detailed booklet, "Let's Look Ahead".*

Attend the Foundry Educational Foundation 10th Annual College-Industry Conference. March 13-14, 1957; Hotel Cleveland, Cleveland, Ohio.

Foundry Educational Foundation

1138 TERMINAL TOWER BUILDING • CLEVELAND 13, OHIO

Space contributed by **modern castings** as another service to the metal castings industry

CIRCLE NO. 117, PAGE 7-8

obituaries

Roy A. Loder, chief inspector of the Erie Malleable Iron Co., Erie, Pa., died at his home in Erie on December 15, 1956 after a long illness. He had been associated with the company since 1921.

Mr. Loder was a charter member

Roy A. Loder

of the Northwestern Pennsylvania Chapter of AFS and served as official chapter photographer and director of publicity for many years. He served on its board of directors in 1951-53.

Harry C. Orr, 74, foundry sales engineer, The C. O. Bartlett & Snow Co., Cleveland, died December 19. He began his career with Bartlett & Snow in 1911 as a draftsman, was

Harry C. Orr

promoted to estimator and then to the foundry sales department.

Mr. Orr had a wide acquaintance and friendship among foundrymen all over the country, was a member of AFS, American Legion, and Newburgh Masonic Lodge.

James J. Callahan, 61, senior metallurgical engineer for the thermal

products division of ALCO Products, Inc., Dunkirk, N. Y., died December 26 after a long illness. He was a graduate of Rensselaer Polytechnic Institute, Troy, and had been associated with ALCO in both Schenectady and Dunkirk since 1917.

Leroy J. Ackermann, 37, eastern representative, Lindberg-Fisher Division of Lindberg Engineering Co., passed away suddenly December 11 at Baltimore, Md.

Albert E. White, professor emeritus of mechanical engineering at The University of Michigan and director emeritus of the university's Engineering Research Institute, died December 18 in Ann Arbor, Mich. at the age of 72 after a long illness. He had been in retirement since June, 1954.

Professor White received his A.B. degree from Brown University and continued engineering studies at Harvard University, becoming research engineer for Jones and Laughlin Steel Co., Pittsburgh. In 1925 he was awarded an honorary Doctor of Science degree by Brown Univ. He joined the staff of the University of Michigan in the department of chemical and metallurgical engineering in 1911. He was a full professor of this department at the age of 35 and appointed director of the department of engineering research, a position he held for 33 years.

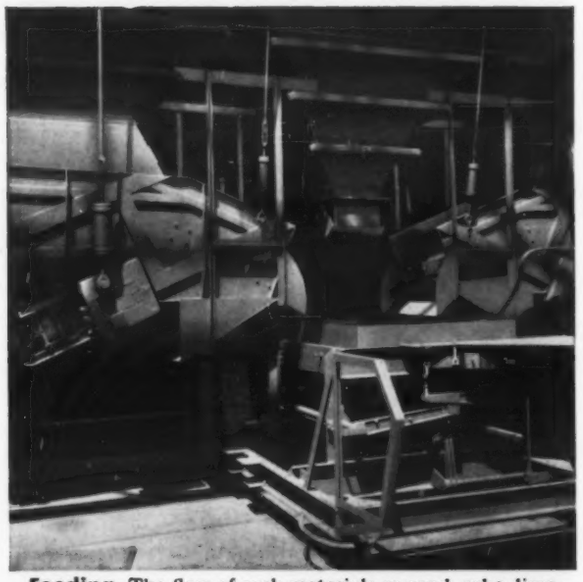
Benjamin F. Reagan, 36, died in the Venezuela plane crash November 27. He was a salesman for the Beloit Iron Works, Beloit, Wis., and was on his way to Caracas to open and manage a sales office there for his company.

Victor Mauck, 82, retired chairman of the boards of John Wood Co. and Nicolet Industries, Inc., died December 2. He was associated with John Wood Co. for 65 years.

Mr. Mauck was the first to perfect the continuous welding of tube steel in large diameters and heavy gauges. He was one of the founders of the American Welding Society.

It's easy to obtain product data with the postage-free Reader Service Cards provided on pages 7-8. Use them for information on advertised products, too. Just circle the key number appearing at bottom of the ad.

JEFFREY puts VIBRATION to work in the foundry



Feeding—The flow of such materials as sand, coke, limestone, iron borings and castings is positively controlled by JEFFREY vibrating feeders. Rate of feed can be changed while a unit is running, and the response is instantaneous. No mechanical adjustments are required and power consumption is low. Units shown are vibrating feeders with grizzly sections, delivering coke and limestone from bin storage to a weigh car.

Conveying—JEFFREY mechanical vibrating conveyors are widely used for handling foundry sand and castings. Their gentle, but positive, conveying action does not tumble or degrade even fragile castings. Units are compact, sturdy and dustproof, with no wearing parts in contact with conveyed materials.

Cooling—Castings move slowly along this JEFFREY mechanical vibrating conveyor, which serves as a cooling means. Similar conveyors within the foundry carry small poured molds to the shakeout.

For a free copy of Catalog 845 describing foundry equipment, write to The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

CIRCLE NO. 118, PAGE 7-8

GOT MELTING PROBLEMS?

Solutions to gray iron foundry problems often come easier to outside consultants. To get expert help, call a Semet-Solvay metallurgist . . . he's a practical foundryman whose job it is to help you.

The high uniform quality of Semet-Solvay Foundry Coke plus expert help from our metallurgist will solve your cupola problems.

SEMET-SOLVAY DIVISION
Allied Chemical & Dye Corporation

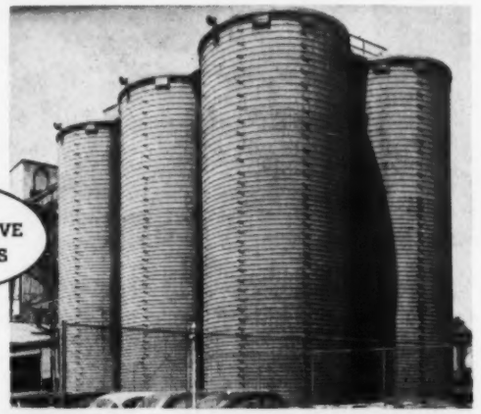
40 Rector Street — *New York 6, N. Y.*
Buffalo • Cincinnati — Cleveland • Detroit

In Canada: SEMET-SOLVAY COMPANY, LTD., Toronto
Western Distributor: WILSON & GEO. MEYER & CO., San Francisco

For Better Melting

CIRCLE NO. 107, PAGE 7-8

There's a heavy conveying system atop these Neff and Fry Bins



A continuous reinforced concrete roof on the six 20' x 52½' bins carries a big screw conveyor with piers, chutes, etc. Observe that there are no additional supports from the ground. The bins themselves support the entire load.

This strikingly proves the load-bearing strength of Neff & Fry Bins. Of course, the bins also have the lateral strength to contain 4,000 tons of grain.

The walls of Neff & Fry Bins are constructed of Super-Concrete Staves. For a complete understanding, read our folder, "Bins With the Strength of Pillars." Ask for it now before you forget.

NOT EXPORTED EXCEPT TO CANADA AND MEXICO

THE NEFF & FRY CO.
212 ELM ST. • CAMDEN, OHIO

CIRCLE NO. 108, PAGE 7-8

for the asking

Industrial brushes are covered in 100 pp catalog. Sections include how to select power brushes, descriptions of power brushes, "Brushamatic" machines, paint and varnish brushes and maintenance brushes. *Osborn Mfg. Co.*

CIRCLE NO. 41, PAGE 7-8

Extra! Fuel burning system bulletin 1231-A, 6 pp, covers packaged combustion assembly utilizing gas, oil or combination firing for modernizing or converting existing boiler equipment. *Orr & Sembower, Inc.*

CIRCLE NO. 42, PAGE 7-8

Storage rack bulletin, 4 pp, covers features and applications including pattern storage. Requires no drilling or welding because of pre-slotting. *Flexangle Corp.*

CIRCLE NO. 43, PAGE 7-8

Grinding wheel bulletin GD-56, 4 pp, explains grinding wheel marking system plus commonly used abrasives and their applications. *Electro Refractories & Abrasives Corp.*

CIRCLE NO. 44, PAGE 7-8

Extra! Heat treating instrumentation data sheets, 5.2-2 and 5.2-4b, cover temperature control of continuous hardening furnaces and temperature control of re-circulating stress-relieving furnaces. *Minneapolis-Honeywell Regulator Co.*

CIRCLE NO. 45, PAGE 7-8

Limestone data sheet lists limestone for foundry uses by size. Has only 47 per cent loss through ignition. *Dolcito Quarry Co.*

CIRCLE NO. 46, PAGE 7-8

Foundry chill nails and spider chills are listed in 4 pp pamphlet with illustrations and price list. *Standard Horse Nail Corp.*

CIRCLE NO. 47, PAGE 7-8

Shell molding resins are discussed in 32 pp booklet "Plaskon Resins for Shell Molding." Includes design and production considerations, available

types of molding machines, gating techniques and precautions, pattern design, special metals handling and sand reclamation. *Barrett Div., Allied Chemical & Dye Corp.*

CIRCLE NO. 48, PAGE 7-8

Extra! Box furnaces with cooling chambers for low production and laboratory production applications are discussed in bulletin GEC-1402, 4 pp. Included are specifications, temperature ratings and dimensions. *General Electric Co.*

CIRCLE NO. 49, PAGE 7-8

Extra! Production furnaces, field-erected, are covered in 4 pp bulletin illustrating installations of furnaces with approaches to automation handling of production materials. *Lindberg Industrial Corp.*

CIRCLE NO. 50, PAGE 7-8

Industrial lighting booklet, "Prescribed Lighting Protects the Eyes of Industry." Twenty-eight page booklet features sections on safety and visibility factors, uses of fluorescent, incandescent and mercury vapor lamps and condensed catalog data

on fixtures. *Sylvania Electric Products Inc.*

CIRCLE NO. 51, PAGE 7-8

Line frequency induction melting furnaces are described in 4 pp folder R-42. Contains diagrams showing induction furnaces, zinc die casting machines and molten distribution system. *Ajax Engineering Corp.*

CIRCLE NO. 52, PAGE 7-8

Extra! Heat treating literature includes annealing furnaces, carbo-nitiriding furnaces, car type furnaces, continuous conveyor types as well as controlled atmosphere, convection, forging and rotary furnaces. *Holcroft & Co.*

CIRCLE NO. 53, PAGE 7-8

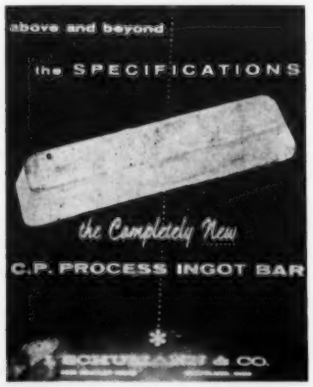
Sandslinger equipment and installations are subject of Bulletin 1515, 28 pages. Complete with pictures, diagrams showing operations and machinery in use. *Beardsley & Piper Div. Pettibone Mulliken Corp.*

CIRCLE NO. 54, PAGE 7-8

Sand preparation equipment, "Mix-Muller", is described in bulletin 489, 8 pp including pictures, descriptions, auxiliary equipment and condensed specifications. *National Engineering Co.*

CIRCLE NO. 55, PAGE 7-8

Extra! Brass and bronze ingots developed by "CP Process" are discussed in 22 pp catalog. Superior qualities claimed



with elimination of rough or smooth top characteristics and sharp edges. Said to have no scale, ash or oxidation evidence. *I. Schulmann & Co.*

CIRCLE NO. 56, PAGE 7-8

Non-acid detergent and rust inhibitor is presented in two-color, twelve-page booklet. Immunol eliminates fire hazards and problems of toxicity and

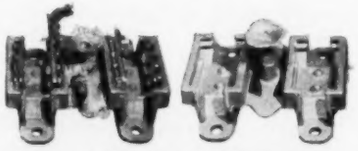
WHEELABRATOR® STEEL SHOT

Plays a Vital Part in Slashing Cleaning Costs in Thousands of Foundries Everywhere

STEEL FOUNDRY CUTS ABRASIVE COST OVER 50%

Walter Berg, Maintenance Supt. of Unitcast Corp., Toledo, reports that they were able to cut abrasive costs from $1.40 per ton of castings cleaned to 60c, a saving of more than 50%, by switching to Wheelabrator Steel Shot.

This is a savings of more than $10,000 a year in shot costs alone. Additional savings accrue in greatly reduced parts wear and maintenance time. Unitcast cleans alloy steel castings such as those pictured below.



Before Cleaning After Cleaning

Get ALL the Facts

about Wheelabrator Steel Shot . . . the abrasive to which over 1,000 plants have changed in the past 2 years. Ask for Bulletin 89-B

$100 Does The Work of $229 When Wheelabrator Steel Shot is Used

$100
ORDINARY ABRASIVE
Cleaned 65 tons of gray iron castings for $100 in abrasive costs.
WHEELABRATOR STEEL SHOT
Cleans 149 tons of castings for $100. To clean 149 tons with the ordinary abrasive previously used cost $229.

Multiple savings were effected at Swayne, Robinson & Co., Richmond, Ind., a gray iron foundry, by converting from ordinary abrasive to Wheelabrator Steel Shot. Abrasive costs were slashed from $1.54 to 67c per ton of castings cleaned — a reduction of 57%. In addition, the general foreman reports, "The wear on our Wheelabrator has been greatly reduced, effecting savings in replacement parts and maintenance labor." Cleaning time has also been reduced —from 7 hours daily to only 4 hours.

Greater Productivity At Less Cost

Wheelabrator Steel Shot, made of heat treated electric furnace steel, is the finest blasting abrasive ever developed. It has the hardness for faster cleaning, the toughness and solidity for longer life; it rebounds for greater coverage; it is always round for low maintenance costs; has a warranted quality for uniform results; and gives performance for lowest overall cleaning costs. Examples of its top flight performance:

	Savings in Abrasive Costs
An Ohio steel foundry	60%
A gray iron valve foundry	40%
An Eastern malleable foundry	38%
A St. Louis steel foundry	51%
A Cleveland gray iron foundry	46%

SAVES 23% ON SHOT COST IN CLEANING ANNEALED STEEL CASTINGS

Crucible Steel Casting Company of Milwaukee cleans large steel castings after heat treating. With ordinary abrasives, the cost per wheel hour was $1.57. With Wheelabrator Steel Shot, the cost per wheel hour has dropped to only $1.215, a saving of 23%. With 10 wheels in the plant blasting 10 hours a day, annual savings in shot cost are estimated at $8,000.

WHEELABRATOR
CORPORATION
630 S. Byrkit Street, Mishawaka, Indiana
World's largest manufacturers of Steel Shot

CIRCLE NO. 120, PAGE 7-8

skin irritations. Product may be applied by wiping, dipping or spraying. *Harry Miller Corp.*

CIRCLE NO. 57, PAGE 7-8

Extra! Direct reading imaging device "Evapograph" is explained in bulletin RD515, 12 pp. Photos, graphs and drawings explain the principles and applications for thermal studies. *Baird Associates-Atomic Instrument Co.*

CIRCLE NO. 58, PAGE 7-8

Castable refractory Bulletin 1992, 4 pp, contains technical information on high temperature "Alundum" which is recommended for protection to 3300 F. Photos show its use. *Norton Co.*

CIRCLE NO. 59, PAGE 7-8

Laboratory chemical price list contains more than 1300 items listed with appendices for industrial and metallurgical chemicals as well as other classifications. *J. T. Baker Chemical Co.*

CIRCLE NO. 60, PAGE 7-8

Preimpregnated glass cloth data sheet covers "803" cloth series a tack free, epoxy formulation. It is fusible to itself, metals or thermosetting plastics. *Furane Plastics Inc.*

CIRCLE NO. 61, PAGE 7-8

Castings More "Saleable"
Right now foundrymen say castings of good quality are more important than ever before. In the present market, they agree, rejects must be at a minimum, and a sound, dense casting product assured.
Marshall Enclosed-Tip Thermocouples are aiding foundrymen to deliver these better, more saleable castings. Using Marshall Thermocouples, the foundryman avoids underheating and overheating of his metals. He knows just when his molten brass, bronze, aluminum and magnesium are right to pour.
Marshall Thermocouples are standard tools throughout the foundry industry. Write for descriptive literature. L. H. Marshall Co., 270 W. Lane Ave., Columbus 2, Ohio.
Marshall
THERMOCOUPLES

CIRCLE NO. 121, PAGE 7-8

Extra! Furnaces, ovens, kilns, atmosphere generators for standard and special applications are covered in booklet 135, 16 pp. Included are photos of installations and descriptions of operations. *Continental Industrial Engineers.*

CIRCLE NO. 62, PAGE 7-8

Valve, boiler mounting and lubricating devices catalog 555, 24 pp is indexed for easy reference. Valves are grouped according to steam pressure. Water, oil and gas ratings are also given. *Lunkenheimer Co.*

CIRCLE NO. 63, PAGE 7-8

Dust control for industry bulletin 922 is a 16 pp illustrated reference. It covers the complete range of dust control equipment and outlines standards of control. *Pangborn Corp.*

CIRCLE NO. 64, PAGE 7-8

Extra! Heat treating castings in two case histories are contained in vol 12, no. 5 and vol 13 no. 1 of "Metal Minutes," both 4 pp. Well illustrated showing equipment in use. *Sunbeam Corp.*

CIRCLE NO. 65, PAGE 7-8

Hydraulic plate shear catalog 305, 8 pp, includes data on controls, construction and dimensions chart. Available in ratings of ⅜ to 1½ in. plate and lengths of 30 ft. *Pacific Industrial Mfg. Co.*

CIRCLE NO. 66, PAGE 7-8

Screw thread inserts may be cast-in or inserted, 4 pp booklet gives performance data, installation procedure and sizes of stainless steel and phosphor bronze inserts. *Heli-Coil Corp.*

CIRCLE NO. 67, PAGE 7-8

Extra! Indicating controllers "400" series, are featured in bulletin 9, 16 pp, designed as flexible unit for controlling the process variable in heat treating furnaces. Operational diagrams, schematic drawings and product information are contained. *Wheelco Instruments Div., Barber-Coleman Co.*

CIRCLE NO. 68, PAGE 7-8

Power tool catalog 57, 52 pp, covers cutting, shaping, drilling and finishing of wood, metal and plastics. Machines covered are band saws, contour saws, band filers, cutters, shapers, drill presses, tool and knife grinders, jig saws, jointers, lathes, planers, belt and spindle sanders, saw jointers, shapers and spinning tools. *Boice-Crane Co.*

CIRCLE NO. 69, PAGE 7-8

Extra! Temperature control of heat treating furnaces is contained in bulletin GER1206, 21 pp, consisting of six articles discussing basic temperature control systems, thermocouples and control instruments, control elements and special control systems. *General Electric Co.*

CIRCLE NO. 70, PAGE 7-8

Steel grit abrasives for non-ferrous finishing are discussed in four-page bulletin. Steeletts are made of specially heat-treated high-carbon steel. *Wheelabrator Corp.*

CIRCLE NO. 71, PAGE 7-8

Extra! Iso-hardness diagram, its development and application are featured in 8 pp reprint. It is well illustrated with charts, graphs and tables. *Metal Treating Institute.*

CIRCLE NO. 72, PAGE 7-8

Air-cooled compressor bulletin AC 15, 16 pp, describes one and two stage models from 85 to 175 psi. Included is chart for figuring compressor needs and another showing estimated air consumption for 30 common shop jobs. *Gardner-Denver Co.*

CIRCLE NO. 73, PAGE 7-8

Pyrometer catalog 175, 8 pp, covers optical, micro-optical, radiation, immersion, surface and indicating types. Included are specifications, prices and special features. *Pyrometer Instrument Co.*

CIRCLE NO. 74, PAGE 7-8

Extra! Casting cleaning highlighted in two, 4 pp reprints. One covers salt bath cleaning of gray iron castings, the second sodium hydride and descaling and desanding of ferrous castings and forgings. *Ajax Electric Co.*

CIRCLE NO. 75, PAGE 7-8

Refractory problems and solutions are discussed in "A Guide For Refractory Selection," 12 pp. Booklet also covers nomenclature applied to classes and types of granular refractories. *Basic Refractories, Inc.*

CIRCLE NO. 185, PAGE 7-8

Metal sawing handbook, 36 pp, covers selection and use of hand and power hack saw blades and band saw blades. Recommended cutting

speeds, feeds and techniques are also tabulated. *W. O. Barnes Co., Inc.*
CIRCLE NO. 76, PAGE 7-8

Extra! Combustion safeguards, automatic fire checks and safety blowouts are detailed in bulletin Sc 1006, 12 pp. Design and construction details are illustrated. *Selas Corp. of America.*
CIRCLE NO. 77, PAGE 7-8

Chill nails catalog, 8 pp, and price list contains actual size pictures. Also contains dimensions and packing information. *Canton Chaplet & Chill Div., W. L. Jenkins Co.*
CIRCLE NO. 78, PAGE 7-8

Process instrumentation catalog no. 2 contains 32 pp on flow, pressure and temperature instruments. Illustrated with photos, cutaways and graphs. *Fischer & Porter Co.*
CIRCLE NO. 79, PAGE 7-8

Extra! Thermocouple bulletin, 8 pp, covers stationary units, portable units, replacement units and parts, and price list. Enclosed tip is inserted 3 in. below surface of molten metal. Instrument may stirred in melt. *L. H. Marshall Co.*
CIRCLE NO. 80, PAGE 7-8

Rubber roll maintenance is outlined in report 11. Table lists common faults and recommended treatments for grooves, cracks and surface damage, lubrication, and cleaning. *Rodney Hunt Machine Co.*
CIRCLE NO. 181, PAGE 7-8

Noise control publication contains American and foreign articles and is confined to noise abatement problems. Said to offer the most authoritative solutions to specific noise problems. *Acoustical Society of America.*
CIRCLE NO. 182, PAGE 7-8

Abrasive cut-off machines, automatic and semi-automatic, for wet and dry operations, are contained in 4 pp catalog, bulletin DH-Y60-B, with pictures and specifications. Also has data on abrasive cutting wheels. *Campbell Machine Div., American Chain & Cable Co.*
CIRCLE NO. 183, PAGE 7-8

Plastic firebrick data sheet has technical data on pyrometric cone equivalents, workability indexes, dry and firing shrinkage, water content and panel spalling. *J. H. France Refractories Co.*
CIRCLE NO. 184, PAGE 7-8

PERMABRASIVE is the only pearlitic malleable iron shot and grit on the market. Pearlitic malleable iron is made with the proper analysis and controlled heat treatment. The result is malleable iron with a more durable structure and, in abrasives, "pearlitic" means a greater resistance to break down, longer life, greater cleaning ability with all the advantages of lower abrasive costs, lower maintenance costs, faster cleaning!

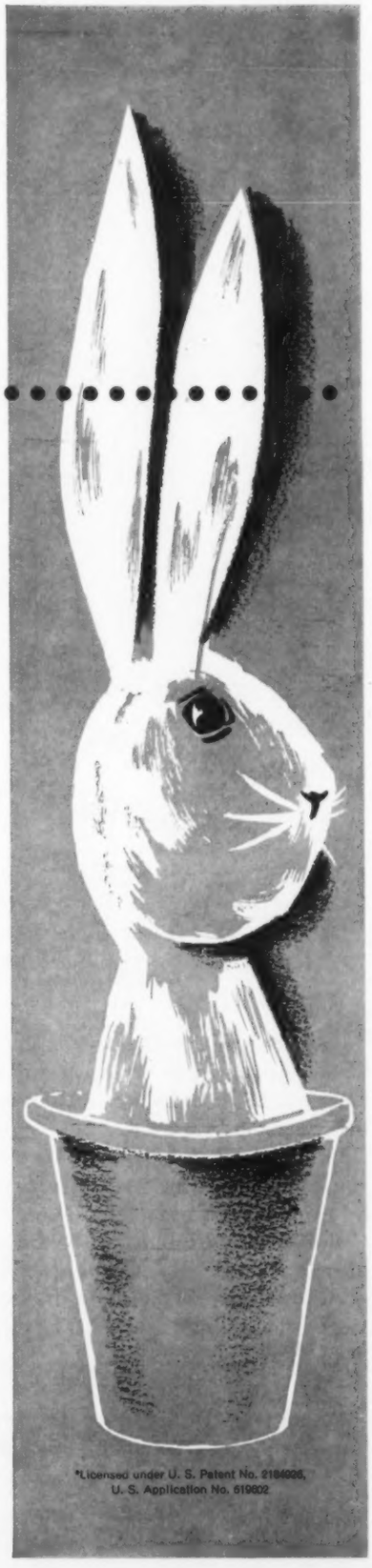
"Pearlitic"..... is a magic word!

National Metal has been making pearlitic malleable shot and grit for several years. Permabrasive—the only pearlitic malleable shot and grit—has been a pioneer in the field of premium quality abrasives and has saved thousands of dollars for hundreds of foundries!

Sure, Permabrasive pearlitic malleable shot and grit costs a little more per ton than ordinary annealed abrasives. That's because it costs more to make. But its use has snow-balled, because it saves money on abrasives used and cuts maintenance costs substantially. *Your* savings are *guaranteed in writing* when Permabrasive goes to work in your blast cleaning room.

TIRED OF TESTING?

No one blames you for being tired of making endless, complicated tests to prove every claim that comes along! We suggest you use a "time-meter"—and reduce your operation to simple "wheel-hours." An office boy can keep the records—doesn't interfere with operations—gives you all the dope you need on abrasive consumption, evaluating materials and equipment parts, and furnishes excellent cost records. Write for free folder: "Tired of Testing!"



*Licensed under U. S. Patent No. 2184026, U. S. Application No. 619802

PERMABRASIVE* PEARLITIC MALLEABLE SHOT AND GRIT IS PRODUCED EXCLUSIVELY BY

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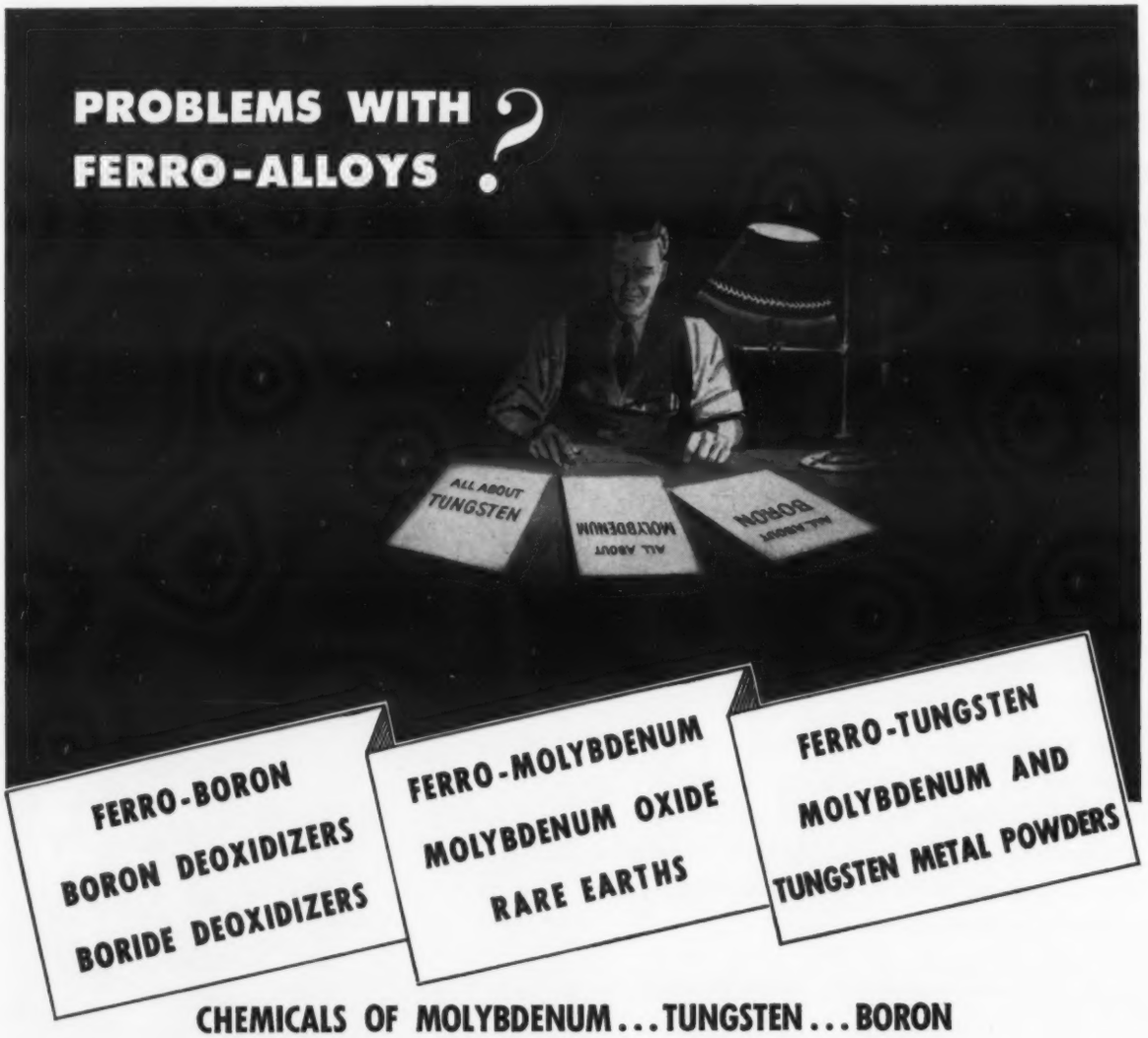
CIRCLE NO. 122, PAGE 7-8



CHEMICALS OF MOLYBDENUM . . . TUNGSTEN . . . BORON

Molybdenum is now available in unrestricted supply to improve strength and machinability. Dependable results are still one of its major attributes.

Tungsten, for hardenability and wearability improvement is now used in surprisingly small additions, with great success.

Boron, as an intensifier of the effects of other alloying materials, may be used in very minute additions, and yet maintain the essential properties of the castings desired. The most economical and satisfactory form to introduce Boron is recognized to be found in MCA's Ferro-Boron.

Operating the world's largest rare earth deposits, the Molybdenum Corporation of America has recently conducted extensive pioneering research in evaluating the properties, applications and uses of RareMeT Compound.

In nodular iron, small additions of rare earths have helped to produce consistently good ductility by counteracting subversive elements such as lead and titanium.

Write today for further information.

MOLYBDENUM

Grant Building CORPORATION OF AMERICA **Pittsburgh 19, Pa.**

Offices: Pittsburgh, Chicago, Los Angeles, New York, San Francisco
Sales Representatives: Brumley-Donaldson Co., Los Angeles, San Francisco
Subsidiary: Cleveland Tungsten, Inc., Cleveland Plants: Washington, Pa., York, Pa.

MCA

CIRCLE NO. 113, PAGE 7-8

Marketing, Research Men Meet At S.F.S.A. Session

In an effort to improve the marketing of steel castings, two sessions of the 11th annual technical and operating conference of the Steel Founders' Society of America, were devoted to bringing marketing personnel together with engineering and research personnel. The conference, held in November at the Hotel Carter, Cleveland, set an attendance record of 636.

Activities on opening day were devoted to discussing the economies of

Howard F. Park

such processes as carbon arc removal, mechanical blast cleaning, new core blowing equipment, carbon dioxide and cold set binders, shell molding and a review of exothermic materials.

Howard F. Park, Jr., S.F.S.A. President, and vice-president, General Steel Castings Corp., Granite City, Ill., spoke at the opening day luncheon. Harry A. Stuhldreher, U.S. Steel Corp., analyzed "The Safety Position" as both a mental problem, as well as one of physical conditions and alertness.

Afternoon discussion centered around developments in molding operations and the growing importance of bentonite quality on the production of steel castings.

A panel discussion on various problems of the steel castings industry opened the second day's activities. Also covered were steel casting requirements in various fields of service applications and a comparison of nodular iron with steel castings.

Inspection as related to quality was featured on the final day. Among the topics discussed were trends in steel casting specifications, the practical application of standards to various types of casting service, the consideration of 100 per cent inspection for highly stressed installations, quality control and the maintenance of presently established dimensional tolerances.

Plans for the 1957 technical and operating conference were made at the close of the session.

Information and art work for Foundry Facts was supplied through the courtesy of the Bolt & Chain Div., Republic Steel Corp.

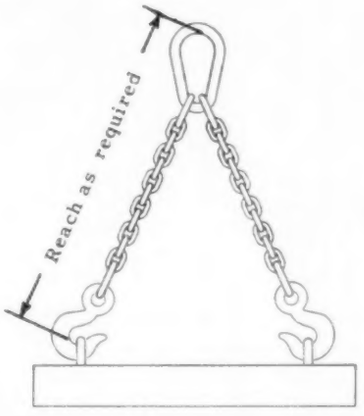
Chains, despite their rugged construction and relatively long life, do wear. With proper use their life can be increased considerably.

These precautions include making certain that: the chain hangs straight; the load is placed as far as possible in the throat and pads are used over sharp corners. Other steps include avoiding kinks and knots, sudden jerks, unbalanced loads, forcing a hook or chain into place and shortening the chain by twisting or using bolts.

Chain slings should be stored by hanging in a clean, dry place out of the weather and oiled if possible. High test chain slings should not be annealed but wrought iron slings should be subjected to this occasionally.

Periodic inspection is important and should be done with the chain hung vertically. A thorough cleaning will reveal defects. Check the sling's reach by comparing it with the original length. If the increase in length is over three per cent it should be analyzed.

Checks should be made for localized stretch or wear. Inspect each link for grooving. If grooving is noticeable, check the wear ratio with standard tables. If no grooving is apparent, check the clearance between links which should have a clearance of 20 to 25 per cent of the stock diameter. Five per cent overload is considered maximum for safety.



Measure reach between bearing points, sling hung vertically.

In link by link inspection look for signs of bending or twisting; cracks in weld areas, shoulders or in any other section; nicks, marks or scores; corrosion pits; lifted fins; excessive wear at bearing points; stretched links and binding. Attachments should also be checked including rings, pear shaped links and hooks. Check hooks especially for breaks in the throat opening.

Table for Wear

Chain Size, Inches	Actual Stock Size-New, Inches	Minimum Safe Diameter at Worn Portion, Inches
1/4	9/32	15/64
3/8	3/8	19/64
1/2	1/2	25/64
5/8	5/8	31/64
3/4	3/4	19/32
7/8	29/32	23/32
1	1- 1/32	13/16
1-1/8	1- 5/32	29/32
1-1/4	1- 9/32	1

Sling assembles are generally made from alloy steel, high test steel or wrought iron. Slings are available in standard sizes; single, double, triple and quadruple. Fitting and accessories are usually made from the same material to give uniformity.

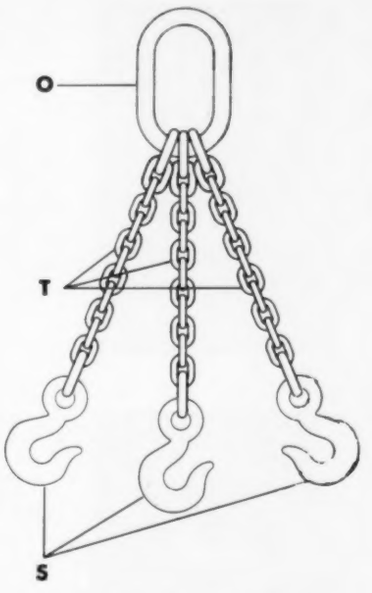
High tensile slings are more than twice as strong as low carbon chain of the same size and are used for the most hazardous heavy duty lifting and overhead materials handling. High test steel slings are designed for a high working load limit with relatively light weight.

Wrought iron chains are recommended where weight is not a factor. When overloaded they will elongate beyond the minimum requirements but the original properties may be restored with annealing. Wrought chains should be inspected periodically since it is relatively soft and subject to nicks and gouges. If chains have been subjected to extremely cold temperatures they should not be used until warmed to normal room temperature.

Five specifications should be included in ordering. They are size, reach, type, accessories and special conditions. Size is the diameter of the material from which the chain link is formed. Reach is the distance from the bearing points when the sling is hung vertically.

Accessories refer to the master rings or hooks and links required. Special conditions include working conditions and working load. Temperatures, corrosive conditions, severe strains, impact, pickling operations and other factors affect the use of slings. In determining the working load special attention should be given to the angle of lift since lifting at an angle greatly affects the stress in chain.

Basic types of chains are designated throughout the industry by a standard set of symbols. Three symbols are used in ordering. The first is the basic type, the second indicates type of master link or end link and the third the hook type.



Symbols designate "TOS" type.

First Symbol

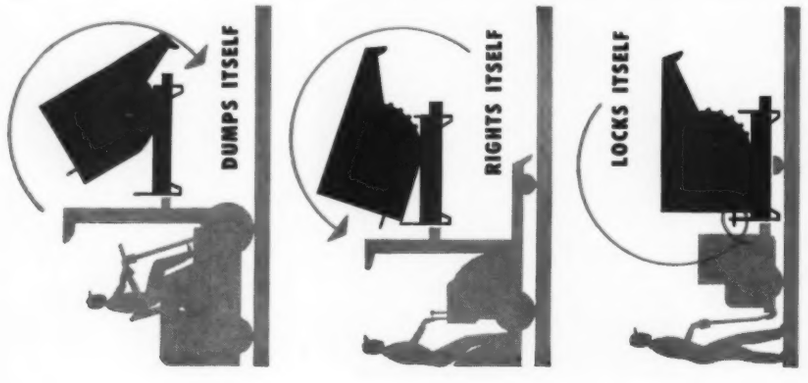
- **S** Single chain sling with master link and hook, or hook each end.
- **C** Choker chain sling, single led with master link each end. No hooks.
- **T** Triple chain sling with standard and master link and hooks.

Second Symbol

- **O** Oblong master link of standard dimensions.
- **P** Pear shaped master link of standard dimensions.
- **R** Master ring.

Third Symbol

- **S** Sling hook.
- **G** Grab hook.
- **F** Foundry hook.



makes every truck a dump truck!

Fits securely on any standard fork or platform lift truck . . . can't slip off. Pick-up is quick and easy. Insures fast, efficient handling of any wet or dry, hot or cold bulk materials. *Cuts hand unloading by at least 50%* . . . with maximum safety.

This rugged Roura Self-Dumping Hopper is built like a battleship . . . extra heavy gauge welded construction . . . to withstand the terrific knocks and bangs of rough usage. Good for years of dependable service. Available in sizes from ½ to 2 cubic yards. Thousands of these time-and-money-savers are now in use by America's biggest industries. Let us show you how they can help cut your costs, too.

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ROURA IRON WORKS, INC.
1412 Woodland Ave., Detroit 11, Michigan

CIRCLE NO. 124, PAGE 7-8

AFS Membership Exceeds 13,000 Mark With 10 Chapters Achieving Quotas

Society only 487 short of quota, drive ends June 30

Already the highest in AFS history, the Society membership is continuing to rise. The latest figure of 13,013 is only 487 short of the membership goal. Ten chapters have reached their quotas. The latest are Saginaw Valley, Chicago, Wisconsin and Tennessee. Previously Eastern Canada, New England, Central Michigan, Corn Belt, Mexico City and Mo-Kan chapters had achieved their goals.

Chapters one to five off their targets are Toledo, Mid-South and Northwestern Pennsylvania. Twelve chapters missed their quota from six to 10 members. They were St. Louis, Quad City, Central Illinois, Texas, Oregon, Central New York, Tri-State, British Columbia, Washington, Ontario, Timberline and Western Michigan. A dozen chapters were 11 to 15 short of the goal. They were Chesapeake, Eastern New York, Pittsburgh, Northern Illinois and Southern Wisconsin, Canton District, Connecticut, Rochester, Northern California, Twin Cities, Western New York and Philadelphia. Eight chapters were 20 or more members off the target. They were Metropolitan, Central Indiana, Southern California, Birmingham, Michiana, Detroit, Cincinnati and Northeastern Ohio.

The membership drive ends June 30. Dan J. Hayes, field director, urges special membership plans for chapters failing to meet their quotas.

Membership certificates will be presented to the chapters at the Chapter Officers' Conference in June.

Need for Executive Training Outlined at Saginaw Valley

Developing of executive talent was the highlight of the October meeting of the Saginaw Valley Chapter. Speaker of the evening was L. L. Ellis, partner, Booz, Allen & Hamilton, Chicago management consultants.

Ellis stated that an individual's executive quotient or "E. Q." is a quality which is acquired and can be improved as contrasted to a person's I.Q. which is natural and inborn.

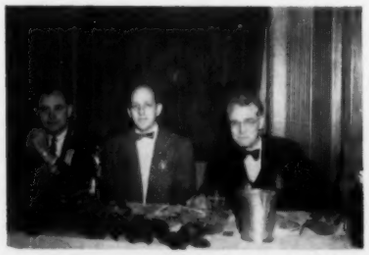
Looking 15 years into the future Ellis said that 75 per cent of the executives of the 400 largest companies would be retired. The problem is even greater than that he emphasized since the rate of growth of our gross national product, projected to 1965, indicates an increase of about 25 per cent. The same projection of addition to the management pool indicates an increase of only 5 per cent. Despite this, less than a third of the 100 largest corporations have programs which will produce beneficial results.

Four important elements in any productive program for the development of executive quotient are: a sound organizational structure; effective appraisal methods; sound development techniques; and a comprehensive and competitive compensation program, Ellis said.

Foundrymen Enjoy Christmas Programs

Christmas parties replaced the usual technical sessions at many of the AFS chapters in December. The **Central Ohio** Chapter held a dinner-dance at the Lincoln Lodge with 150 attending. The **Timberline** Chapter held a Christmas party at the Oxford Hotel with 37 attending. **Twin City** Chapter members held their 14th annual Christmas party at the Leamington Hotel and 325 attended the **Quad City** Chapter Christmas party held at the Blackhawk Hotel, Davenport, Iowa. The **Metropolitan** chapter's party was held at the Essex House and the **Connecticut** Chapter held a joint party with the Connecticut Non-Ferrous Foundrymen's Association at the Waverly Inn, Cheshire, Conn. **Wisconsin** Chapter members held their Christmas party in Milwaukee.

Quad City Chapter met in Davenport.



Metropolitan members at Essex House.

local foundry news

Prior to the December meeting of the **Chicago Chapter,** castings were discussed in informal sessions. Left to right are George DiSylvestro, Burnside Steel Foundry; Robert Greenlee, Auto Specialties Mfg. Co., St. Joseph, Mich.; Clyde Sanders, American Colloid Co. and Bob Schauss, Chapter President.

Canton's November meeting was held at the Elk's Club, Barberton, Ohio. Among those attending were Alex Barczak, Superior Foundry Co., Cleveland; Frank Cech, Cleveland Trade School and member of the advisory groups of the American Foundrymen's Society education and pattern divisions; A. S. Morgan, Babcock & Wilcox Co., Barberton, Ohio and T. W. Harvey, Grabler Mfg. Co., Cleveland.

Lehigh Valley Foundrymen's Association held a technical meeting on CO_2 mold and core making in December on the campus of Lafayette College, Easton, Penn. Robert Latham, chairman, presided with Charles Brochini, Lehigh, Inc., serving as technical chairman. Speakers were Paul H. Ducharme, Doran Foundry Div., Columbian Bronze Corp.; Hans Jacob, Lehigh, Inc.; and Frank E. Shumann, Lehigh, Inc. Shown left to right are Ducharme, Latham, Shumann, Jacob and Brochini.

Ontario Discusses Core Methods

Three speakers discussed new developments in core making at the December meeting of the **Ontario Chapter.** J. H. King, Archer-Daniels-Midland Co. Ltd. outlined the fundamental principles and procedures of the cold setting core process; V. H. Furlong, Foundry Services (Canada) Ltd., covered the CO_2 core process and W. R. Moggride, Ford Motor Co. of Canada Ltd. spoke on manufacturing of shell cores and the materials and equipment required.

Northern California members in December toured the foundries of General Motors Corp., East Oakland. Company personnel shown l to r are W. E. Butts, president; Philip Thayer, vice-president; Philip McCaffery, plant manager and John Schaeffer, manufacturing manager.

Members of the Student Chapter of Texas A & M College prepared and conducted the December meeting of the **Texas Chapter.** Edwin E. Pollard, Tyler Pipe & Foundry Co., spoke on water-cooled cupolas. L to R are Alex Beardon, Texas Chapter President; Charles Crow, President, Texas A & M Student Chapter; E. E. Pollard, Carl Liversay, student.

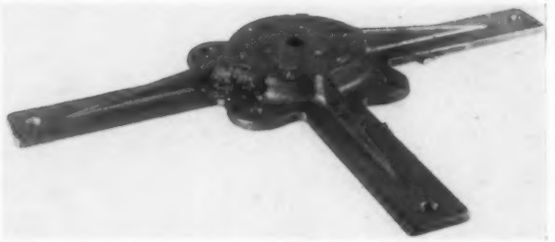
Toledo chapter members at the November meeting heard Clyde A. Sanders, American Colloid Co., discuss casting finish, tolerance and precision. Sanders, shown in photo, stated that many problems are due to poor practices.

Continued on page 82

VOLCLAY BENTONITE
NEWS LETTER No. 49

REPORTING NEWS AND DEVELOPMENTS IN THE FOUNDRY USE OF BENTONITE

CRUSH



**A crush is generally defined as an indentation in the casting surface, which produces irregular-shaped cavities on the casting. Displacement of sand at mold joints, or core prints, lead to crushes.*

PRINCIPAL CAUSES:

Improperly matched or warped flask. Weight too heavy for the mold. Careless closing of the cope on the drag. Core prints too small for the core. Tight cores. Cores placed carelessly in the core prints. Worn equipment.

GENERAL CAUSES:

CAUSED BY MOLDING EQUIPMENT

Worn pins and guides are a chief source of crushes. Improperly fitting jackets causing a shift of the cope. Worn stripping plate on the molding machine. Improperly matched flasks.

CAUSED BY PATTERN EQUIPMENT

Worn pattern or core box. Warped pattern plate on cope and drag core equipment. Lack of crushing strips. Core prints made too small to support the core. Incorrect size pins and guides. Misalignment of cope and drag patterns. Patterns not correctly mounted.

CAUSED BY CORES

Core assembly incorrect. Cores too large for core print. Warped driers. Cores sagged out of shape.

CAUSED BY AUXILIARY MOLD & CORE EQUIPMENT

Weights too heavy which may carelessly be placed on the mold. Warped bottom boards. Weak bottom boards. Dropping the weight on the mold. Rough handling.

CAUSED BY MOLDING PRACTICE

Carelessness is the greatest cause of crushes. Weak flask joints that are not wedged carefully contribute to this scrap. Incorrect chaplets placed in the mold. Uneven clamping. Careless closing of the mold. Improper or careless setting of the jackets.

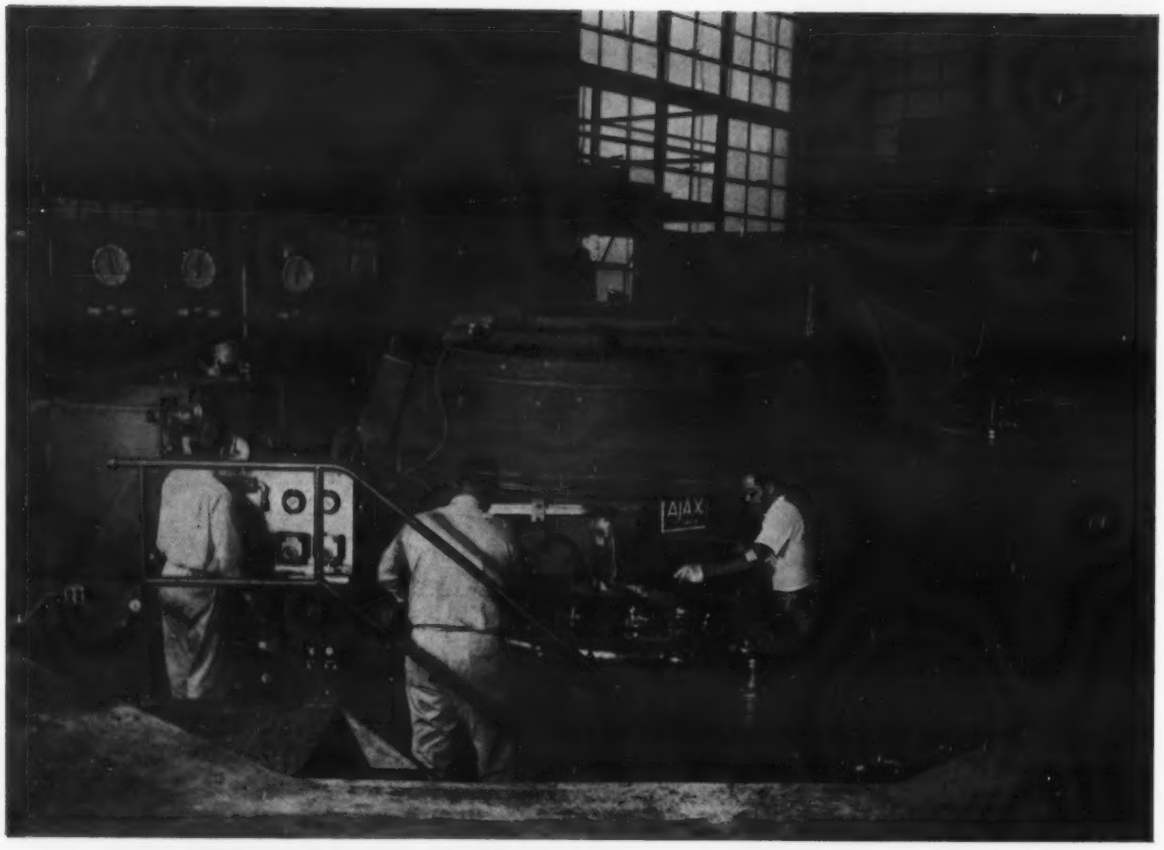
CAUSED BY MOLDING SAND

It is claimed that a low deformation creates crushes but this is a minor cause of the defect. Low green compression strength, combined with low tensile strength may cause a cope to sag resulting in a crush but this is not a major factor. Volclay Western Bentonite with higher deformation is the best bond to use in a sand mixture if the cause is thought due to molding sand. However, the major sources should be carefully investigated before condemning a molding sand practice.

AMERICAN COLLOID COMPANY

Chicago 54, Illinois • *Producers of Volclay and Panther Creek Bentonite*

CIRCLE NO. 125, PAGE 7-8



MODERN ALUMINUM BILLET CASTING

Only the best in extrusion billet quality is good enough for **The Himmel Brothers Company**, Hamden, Conn. They produce architectural aluminum extrusions, most of which are subsequently anodized. Their new electric billet casting shop using an integrated group of induction melting furnaces has assured a consistent supply of top quality extrusion billets.

Billets are turned out at the rate of 2000 lbs. per hour by one supervisor and two men. Clean and cool working conditions, extensive automation, and negligible furnace maintenance provide a high return on this investment.

We should be pleased to give you more facts about this modern way of melting aluminum.

AJAX TAMA-WYATT

AJAX ENGINEERING CORP., TRENTON 7, N. J.

INDUCTION MELTING FURNACE

AJAX ELECTRO METALLURGICAL CORP., and Associated Companies
AJAX ELECTROTHERMIC CORP., Ajax-Northrup High Frequency Induction Furnaces
AJAX ELECTRIC CO., The Ajax-Hultgren Electric Salt Bath Furnace

CIRCLE NO. 123, PAGE 7-8

local foundry news

Continued from page 81

Maryland Engineers to Meet

Maryland professional engineers will hold their second annual dinner February 20 at the Lord Baltimore Hotel. The dinner is a joint program sponsored by the Maryland Society of Professional Engineers and affiliated societies. Principal speaker will be George S. Trimble, Jr., Glenn L. Martin Co. who will discuss "Engineering—America's Greatest Resource."

WALTER V. NAPP

Buffalo Chapter members at the December meeting heard Thomas E. Barlow, International Minerals & Chemical Corp., discuss getting the most of green sand molding.

Northeastern Ohio Starts 1957 with Active Program

Northeastern Ohio's Chapter will present a television program Feb. 10, on station KYW-TV. This is one of a series of programs sponsored by the Joint Engineering Societies Council. Plans were made for this at the November meeting. Chairman A. D. Barczak also gave a progress report on the $3½ million Cleveland Trade School to which the chapter has presented a blast cleaning machine and a milling machine.

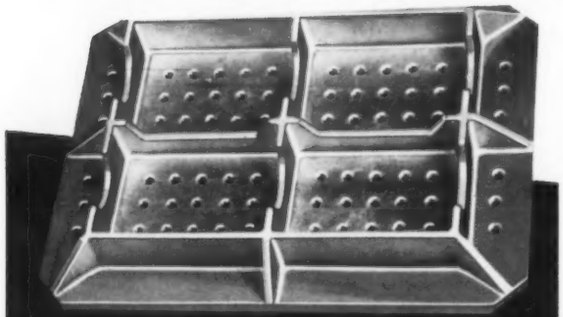
John A. Mueller, Carborundum Co., spoke on snagging and cutoff operations. For maximum efficiency the speaker recommended constant surface speed, pressure consistent with the type of work, use of dense structure wheels and operation at the highest permissible speed.

The Harry W. Dietert Sand School will be held at Case Institute of Technology in March.

Utah Selects Officers

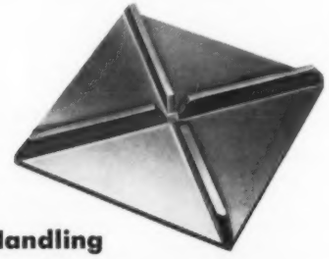
Officers and steering committee members have been named for the AFS Utah Chapter which held its second meeting in November at Provo, Utah. The Chapter was officially accepted into the Society January 21.

Officers and directors are: Chairman, A. S. Klopf, American Gilsonite Co.; 1st Vice-Chairman, C. C. Cardall, Pacific States Cast Iron Pipe Co.; 2nd Vice-Chairman, D. N. Rosenblatt, American Foundry & Machine Co.; Secretary, E. R. Rowe, American Gilsonite Co.; Treasur-



ALUMINUM BOTTOM BOARDS
give Infinite Life—Uniform Molds

JO-EL aluminum bottom boards have *infinite* life—assure uniform molds each cast. They eliminate the ever-increasing cost of labor and materials in making and continually replacing short-lived, old-fashioned wooden boards that produce castings of questionable quality. Designed by practical foundrymen for better results and easier operation, they are cast of aluminum for light weight combined with maximum durability. Vent holes on face permit gas escapement. Will not warp or burn, are not affected by weather. Optional raised sand strip around outer edge peens each mold uniformly and eliminates sand slippage. Rib reinforcement assures added strength and durability. Stacking problems are eliminated. When you use JO-EL aluminum bottom boards, you eliminate a major source of foundry headaches and substantially reduce costs.



ALUMINUM CORE PLATES
for Lightweight Handling

JO-EL light-weight aluminum core plates cut two man operations to one man. Exclusive design permits circulation below plate for much faster conduction than steel. They cut baking cycle time substantially, making possible increased casting production. Distribution of heat is more even, for a better finished product. You eliminate *all* core plate problems when you use JO-EL light-weight aluminum core plates.

COMPLETE JO-EL ENGINEERING AND MANUFACTURING SERVICES

JO-EL bottom boards and core plates are designed and built to your specifications. Just send us a rough sketch and dimensions of the bottom boards and core plates you need, plus an indication of the quantity of each desired, and we'll provide a prompt quotation. For money-making aluminum bottom boards and core plates, write, wire or call:

JO-EL COMPANY
Town & Country Building, 6188 Pearl Rd., Cleveland 30, Ohio
Phone: TUxedo 6-0434
CIRCLE NO. 130, PAGE 7-8

er, Fred Hafen, Pacific States Cast Iron Pipe Co. Directors for one year are: Everett H. Backman, Backman Foundry Co.; Jack May, Lundin & May Foundry Co. Directors for 2 years: Joy Nielson, Columbia-Geneva Steel Div., U. S. Steel Corp.; Byron R. McKay, Star Brass Foundry & Refining Co.; Directors for 3 years; J. N. Carter, American Foundry & Machine Co.; W. W. Brown, Pacific States Cast Iron Pipe Co.

Committee members are: program, C. C. Cardall; membership, L. C. Skelton, Columbia-Geneva Steel Div., U. S. Steel Corp.; entertainment, Glen Brown, Lundin & May Foundry Co.; reception and attendance, E. H. Backman; publicity, J. Merrill Bushnell, Pacific States Cast Iron Pipe Co.

Three evening sessions for improving foundry teaching techniques were held recently for high school metal shop teachers by the AFS **Southern California Chapter.** Instructors brought castings which were analyzed by Fred Dye, Burndy Engineering Co., Inc. who represented the Chapter. Other classes will be held in the future.

Twin-Cities Start Seminars

Four seminars for foundrymen have been scheduled for February by the Twin-City chapter. The meetings will be held at the University of Minnesota Engineering building.

The seminars will be based on practices currently used and are designed to appeal to foundrymen as well as purchasing agents and casting designers. Tolerances and design will be emphasized to demonstrate the capability of castings.

Speakers for the series are Prof. Fulton Holtby, University of Minnesota; H. M. Patton, American Hoist & Derrick Co.; M. W. Schroeder, C. W. Olson Co.; and D. B. Fulton, Northern Malleable Iron Co.

St. Louis Chapter members at the November meeting heard J. B. Caine, foundry consultant. He is at the left listening to R. H. Jacoby, St. Louis Coke & Foundry Supply Co., program technical chairman.

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Schneible equipment for the control of dust, fumes and vapors is designed for all foundries, small or large.

More than twenty years of experience in the solving of varied problems of foundry air pollution go into every collector manufactured by Schneible.

Recent improvements in design and application make the Schneible Multi-Wash a most efficient and economical unit. These design changes now allow you to own the absolute best in wet dust collection equipment at a greatly reduced cost per 1,000 CFM of air handled.

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SERVING FOUNDRYMEN THE WORLD OVER

CIRCLE NO. 131, PAGE 7-8

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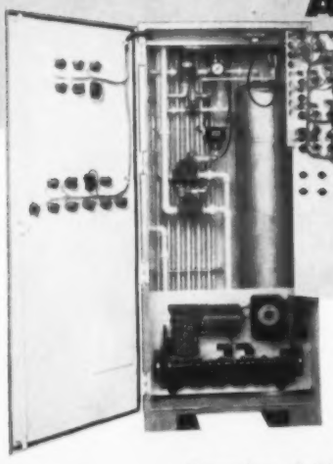

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CIRCLE NO. 119, PAGE 7-8

casting through the ages

Six of the signers
OF AMERICA'S DECLARATION OF INDEPENDENCE WERE ACTIVE IN IRON FOUNDING.
IN ANCIENT ROMAN DAYS, BRONZE FOUNDERS OF BELGIUM AND SURROUNDING TERRITORY, WERE PRODUCING POTS, PANS, SMALL OBJECTS AND FURNITURE FITTINGS THAT WERE KNOWN AND USED—BEYOND THE LIMITS OF THE EMPIRE.
TO CRUSH RISING INDEPENDENT IRON OPERATORS—AND TO BRING THE INDUSTRY UNDER STATE CONTROL—THE AUTHORITIES OF CHINA, A CENTURY BEFORE THE CHRISTIAN ERA, APPOINTED AS GOVERNMENT OVERSEERS MEN WHO ALREADY HAD ENRICHED THEMSELVES THROUGH PRIVATE DEALINGS IN IRON!
Odd Bits
As Late As 1825, NEW YORK AND PHILADELPHIA STOVE-ASSEMBLERS USUALLY USED IRON CASTINGS MADE DIRECT FROM THE ORE BECAUSE IT WAS POPULARLY BELIEVED THAT SUCH CASTINGS WERE STRONGEST

dietrich's corner

by h. f. dietrich

In the days when the study of foremanship was young, I found in a published course on foremanship a question which I have been unable to provide with a satisfactory answer. It was, "Foreman number one puts into practice ten improvements all suggested by the men under his supervision. Foreman number two puts into practice ten improvements none of which were suggested by employees. Which is the best foreman?"

The wording of this question brings up several questions concerning foreman number two. Did he pass up suggestions of the men under his supervision? Did he assume that suggestions by other personnel were unworthy of consideration? Did he steal the suggestions of others and present them as his own? Was he a superman, or a heel?

Suggestions for improvement can come from the most unexpected sources.

A number of years ago, I hired as a gangwayman a pathetic character who—in his all too brief scholastic career—had acquired the nickname of BoBo. From long experience BoBo had become philosophically tolerant of man's inhumanity to man. As a matter of course, he expected to be the butt of crude horseplay. Times without number he had found burning cigarette butts in his hip pockets. At least once a day he found it necessary to remove grease from wheelbarrow handles. Any wheelbarrow already loaded with sand was approached with caution until he was sure that pig iron had not been used for ballast under the sand. Although he fumed visibly, he never complained about the rude treatment.

When I tried to address him by his given name, he suggested that I call him BoBo as did the rest of the crew. It was evident that he considered horseplay a form of attention; it gave him a sense of belonging to the crew. So, I passed the word by shop grapevine that anyone who overenthusiastically injured BoBo would make me very unhappy, and would be subject to drastic action.

BoBo proved to be a loyal and dependable gangwayman who took pride in his ability to provide equipment for every need.

We took an order for chilled tappets that provided me with several headaches. After trying every chill surfacing from shellac to acetylene smoking, I found that nothing in my experience provided the answer to the smooth chill surfaces required for the job.

As I sat on my heels addressing the chill plates in a language suited to the frustration I felt, BoBo squatted beside me. No doubt we would have made an interesting camera study. BoBo, his clothes burned in various places by sparks from the bull ladle, torn shoes with laces tied in innumerable knots, and crooked teeth stained by a lump of Copenhagen which puffed his upper lip like a severe swelling. And me with my hat pushed back on my head to provide a place for a perplexed scratching. Both of us starting at an inanimate, yet obstinate, chill plate.

In a desperate attempt to orient my own thoughts, I explained the problem in detail to BoBo. After a few minutes of silence in which he respectfully digested the common knowledge I had given him, he shifted his cud of Copenhagen several times, did a sloppy job of spitting toward a rathole, turned his battered painter's cap a quarter turn and said, "Why don't you try the bayberry pattern cleaner? It will keep the plate from rusting when the mold is put on it, and the wax will burn off without leaving dirt in the casting."

I told BoBo to clean up some chill plates and try it. I knew he had found the answer to the problem, but I wanted him to prove it to me. When the castings were poured and inspected I made a point of feeding through the grapevine the fact that BoBo had licked the job.

This was a simple solution to my problem. I should have thought of it myself—but I didn't. Most solutions are simple when we look at them in retrospect. I wonder how many foundrymen pass up improvements that are given them by illiterate helpers.

Which brings us back to the first question. Should a good foreman think up all of his own improvements, or should he be ready and willing to take and use suggestions from anyone who has a good idea?

Continued from page 61

Technical Papers

Following is a tentative list of papers being prepared for the technical sessions of the Castings Congress.

▪ **Light Metals Division:** Mechanical Properties of 6221 Titanium Alloy, Status of the Art in Titanium Casting, Corrosion of Aluminum Die Castings, Vacuum Die Casting, Die Casting of Magnesium Alloys, Mechanical Properties of Die Casting Alloys, Permanent Mold Casting Practice, Properties of Green Sand and Shell Mold Castings, Test Bar Properties of Light Metals, Properties of Castings and the Effects of Defects in 195 and 355 Alloys, Stress Relief of Sand Castings, Engineered Light Metal Castings (Round Table Luncheon), Effect of Section Thickness on Chilled Designs in High Strength, High Ductility Aluminum Alloy Castings, Rigging Design of a Typical High Strength, High Ductility Aluminum Alloy Casting, Monolithic Construction in Foundry Furnaces, Expendable Graphite Molds in Production of Sound Ductile Titanium Castings Control Gas Contained in Foundry Work, Effect of Nitrogen and Vacuum Degassing on Properties of Aluminum Silicon Magnesium Alloys, Effect of Iron Additions on Properties of Cast Titanium Aluminum Alloys, Intricate Small Diameter Coring for Aluminum and Magnesium Alloy Castings, Aging Practices for High Strength Aluminum Alloy H T 356.

▪ **Malleable Division:** New Foundry Methods, Use of Cobalt 60 in Foundry Applications, Report of Pearlitic Malleable Committee, Galvanizing Embrittlement of Malleable Castings, Combustion Control in Air Furnace Practice, Continuation of Work on Spheroidal Iron, Progress Report, AFS Malleable Research Project.

▪ **Gray Iron Division:** Heat Treatment of Cast Iron, Residual Stress in Gray Iron Castings, Microscructure vs. Mechanical Properties of Gray Iron, Control of Microscructure and Machinability of Gray Iron, Effect of Shakeout Conditions on Microstructure of Gray Iron Castings, Tin as a Useful Alloy in Gray Iron, Basic Structures as Steps to Quality Casting (Shop Course), Inoculation of Gray Iron—Relative

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Foundrymen . . . Designers . . . AFS members . . . non-members . . . obtain official admission badges in advance of the 1957 AFS Castings Congress, Cincinnati, May 6-10. Avoid filling out cards or waiting in line for badge to be typed. Be free to greet your friends, see the exhibits, and attend the meeting of your choice without inconvenience or delay.

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If you prefer to register at the Congress, fill in one of the Advance Registration Cards and bring it with you to Cincinnati. Won't save as much time but it's faster than starting from scratch after you arrive.

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Effectiveness of Some Silicon Alloys and Active Metals as Ladle Additions, Gating of Gray Iron Castings, Nickel Alloyed Normalized Ductile Irons, Temper Embrittlement in Nodular Cast Irons.

- **Brass & Bronze Division:** Aluminum Alloyed, Copper Nickel Alloy, Notch-Ductility of Brass and Bronze, Effect of Geometry on the Properties of Gunmetal and Aluminum Bronze, Casting Clinic—"Casting Difficulties Due to Poor Design," Effect of Small Tin and Cadmium Addition to Binary Aluminum-Rich Copper Alloys, Cooperation for Technical Advancement in the British Brass and Bronze Foundry Industry.
- **Steel Division:** Welding of Steel Castings with CO_2 Gas as a Shielding Agent, Modified Grade "B" Steel, Grain Refinement of Stainless Steel Castings, Austenitic Manganese Steel Technology in an Australian Foundry.
- **Pattern Division:** Plastic Patterns, Cast Epoxy Pattern Equipment, Variety of Pattern Shop Plastic Applications, Wear Characteristics of Plastic Pattern Materials.
- **Industrial Engineering & Cost Committee:** Costs and Their Relations to Profit, Improving Foundry Layout, Materials Handling, Job Evaluation.
- **Fundamental Papers Committee:** Investigation of Action on Ferrosilicon by the Inoculation of Cast Iron and the Effect of Magnesium on the Formation of Nuclei, Influence of Vibration on Solidifying Metals.
- **Heat Transfer Committee:** Some Generalized Solidification Studies, Temperature Drop in Pouring Ladles.
- **Sand Division:** Oil Bonded Sand for Precision Casting, Water Requirements of Molding Sands, Measurement of Casting Surface Roughness, Influence of Sand Grain Distribution on Green Sand Casting Finish, Materials, Their Effect on Green Core Properties, Effect of Temperature on the pH of Foundry Sand, Pictorial Comparison of Veining Tendencies, Mold Hardness: What it Means, Influence of Various Bonding Materials on Stress Strain Characteristics of Bonded Sands, Properties of Molding Sands Under Conditions of Gradient Heating.

afs chapter meetings

FEBRUARY

1 . . Western New York . . Sheraton Hotel, Buffalo, N. Y. Philip S. Savage Jr., McCallum Bronze Co.; Loran Wright, Symington Gould Corp.; H. C. Ahl, Samuel Greenfield Co.; Ezra Kotzin, Pratt & Letchworth. Shop Talks, Nonferrous and Steel.

1 . . Mo-Kan . . Fairfax Airport, Kansas City, Kans. AFS Film, *"Effect of Gating Design on Casting Quality."*

4 . . Central Illinois . . American Legion Hall, Peoria, Ill. Kenneth MacKay Smith, Consultant, *"Quality Control in the Foundry."*

4 . . Central Indiana . . Athenaeum Turners, Indianapolis. Herbert J. Weber, director safety, hygiene and air pollution control program, AFS, *"Safe Foundry Working Conditions."*

4 . . Chicago . . Chicago Bar Assn., Chicago. Round Table Meeting. Gray Iron Div.: H. H. Wilder, Vanadium Corp. of America, *"Practical Inoculations of Gray Iron;"* Malleable Iron, Steel & Patterns Div.: R. C. Frank, Superior Malleable & Steel Foundry Co., *"Design & Application of Malleable Steel Castings;"* Non-Ferrous Div.: F. L. Ridell, H. Kramer & Co., *"Non-Ferrous Gating & Risering;"* Maintenance & Engineering Div.; R. Schadt, Westinghouse Electric Co. (Illustrated Talk), *"Electrical Equipment for Foundries."*

4 . . Metropolitan . . Essex House, Newark, N. J. Howard F. Taylor, Massachusetts Institute of Technology, *"Chemistry and Mechanics of Molding Materials."*

4 . . Mexico City . . Chamber of Industries Hall, Chapultepec, Mexico City. Joseph Krishon, Mueller Brass Co. de Mexico, *"Brass and Bronze Foundry Practice."*

4 . . Western Michigan . . Doo Drop In, Muskegon, Mich. Panel Discussion on Preventive Maintenance.

6 . . Toledo . . Heather Downs Country Club, Toledo, Ohio. C. W. Vokac, Hydro Arc Furnace Div., Whiting Corp., *"Electric Arc Furnaces in Iron and Steel Foundries."*

7 . . Canton District . . Barberton Elks Club, Barberton, Ohio. J. G. Kura,

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at the Shakeout!

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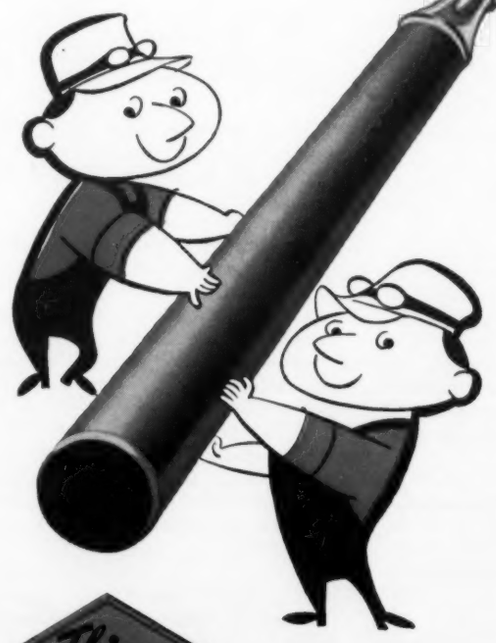
A 16,000 pound steel casting at Riverside Foundry, Bettendorf, Iowa, as it appeared after the shakeout.

THIEM men working with Riverside foundrymen on green sand facing, sprayed with MOLD LITE S and torch dried — performed this operation completely without interruption of production.



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CIRCLE NO. 132, PAGE 7-S

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CIRCLE NO. 133, PAGE 7-8

Battelle Memorial Institute, *"Effect of Gating Practice."*

8 . . Corn Belt . . Fireside Restaurant, Omaha, Nebr. *"Quality Control."*

8 . . Eastern Canada . . Sheraton Mount Royal Hotel, Montreal, Quebec. T. E. Barlow, sales mgr., Eastern Clay Products Dept., International Minerals & Chemicals Corp. *"High Pressure Molding."*

8 . . Mid-South . . Claridge Hotel, Memphis, Tenn. Management from Mid-South Foundries, *"Know Your Area Foundries."*

8 . . Philadelphia . . Engineer's Club, Philadelphia. *"Developments in the Foundry Industry."*

8 . . Southern California . . Rodger Young Auditorium, Los Angeles. A. M. Clark, Ford Motor Co., *"Core Blowing."*

9 . . Saginaw Valley . . Bancroft Hotel, Saginaw, Mich. Annual Ladies' Night Dinner Dance.

11 . . Cincinnati District . . Elks Home, Hamilton, Ohio. C. E. Drury, Central Foundry Div. GMC, *"Pouring Effect On Scrap."*

11 . . Central Ohio . . Seneca Hotel, Columbus, Ohio. Harry H. Kessler, Sorbo-Mat Process Engineers, *"Gating and Risering."*

11 . . Michiana . . Club Normandy, Mishawaka, Ind. Harry E. Gravlin, Jr., Claude B. Schneible Co., *"Dust & Fume Control With An Eye To The Future."*

11 . . Rochester . . Joint meeting with A.S.M.

11 . . Timberline . . Oxford Hotel, Denver, Colo. AFS Film, *"Study of Fluid Flow of Light Alloys Through Vertical Gating Systems."*

12 . . Twin City . . To be replaced by the Educational Program which convenes at the University of Minnesota.

12 . . No. Illinois-So. Wisconsin . . Lafayette Hotel, Rockford, Ill. C. V. Nass, Beardsley & Piper Div., Pettibone-Mulliken Corp., *"Mechanization for the Small Foundry."*

13 . . New England . . University Club, Boston. Prof. H. F. Taylor, Massachusetts Institute of Technology, *"Molding Material."*

13 . . Oregon . . Heathman Hotel, Portland, Ore.

13 . . Utah . . Deseret Inn, Salt Lake City. Joint meeting with A.S.M., K. L. Clark, International Nickel Co., Inc., *"Ductile Iron."*

14 . . Central New York . . Onandaga Hotel, Syracuse, N. Y., H. Kessler, Sorbo-Mat Process Engineers, *"Gating and Risering."*

14 . . St. Louis . . York Hotel, St. Louis. O. J. Myers, Reichold Chemicals, Inc., *"Which Process."*

14 . . Northeastern Ohio . . Tudor Arms Hotel, Cleveland. Howard H. Wilder, Vanadium Corp. of America, *"Practical Cupola Operation."*

14 . . Washington . . Seattle.

14-15 . . Wisconsin . . Hotel Schroeder, Milwaukee, Wis. Twentieth Annual Regional Foundry Conference.

15 . . Tennessee . . Hotel Patten, Chattanooga, Tenn. William Dawson, Ford Motor Co., *"Water Cooled Cupolas."*

15 . . British Columbia . . Pacific Athletic Club, Vancouver. A. M. Clark, Ford Motor Co., *"Core Blowing."*

15 . . Texas . . Hotel Beaumont, Beaumont, Texas. Film on Rice vs. Texas A & M Game. A. B. Keckley, Texas Electric Steel Casting Co. Discussion on Plant Safety.

15 . . Tri-State . . Alvin Hotel, Tulsa, Okla. R. H. Jacoby, St. Louis Coke & Foundry Supply Co., *"Quality Control in the Foundry."*

16 . . Chicago . . Knickerbocker Hotel. *Annual Ladies Night.*

18 . . Pittsburgh . . Webster Hall Hotel, Pittsburgh, Pa. N. A. Birch, National Bearing Div., American Brake Shoe Co., *"Nonferrous Foundry Practices."*

18 . . Quad-City . . Hotel Ft. Armstrong, Rock Island, Ill. C. E. Westover, Westover Engineers, *"Mechanization for Small and Large Foundries."*

19 . . Eastern New York . . Panetta's Restaurant, Menands, N. Y. *"Know Your Foundries" Night.*

20 . . Central Michigan . . Hart Hotel, Battle Creek, Mich. John R.

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CIRCLE NO. 126, PAGE 7-8

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CIRCLE NO. 127, PAGE 7-8

Nieman, Shell Process, Inc., *"Jobbing With Shell Cores & Molds."*

21 . . Detroit . . Tuller Hotel, Detroit. *Management Night.*

21-22 . . Birmingham District . . Tutwiler Hotel, Birmingham, Ala. 25th Annual Southeastern Regional Foundry Conference.

22 . . Ontario . . Royal Connaught Hotel, Hamilton, Ont. R. M. Olson, Dike-O-Seal Corp., *"Improvement in Core Blowing Techniques."*

25 . . Northwestern Pennsylvania . . Amity Inn, Erie, Pa. W. M. Ball Jr., *"The Effect of the Design on the Making of a Casting."*

26 . . Connecticut . . Waverly Inn, Cheshire, Conn. *Five Member Panel Discussion, Malleable Iron.*

Chesapeake . . No February meeting.

Northern California . . Meeting plans not completed.

MARCH

1 . . Chesapeake . . Engineers Club, Baltimore, Md. B. N. Ames, Columbia Bronze Corp., *"CO_2 Molding."*

4 . . Central Illinois . . American Legion Hall, Peoria, Ill. W. H. Dawson, Ford Motor Co., *"Water Cooled Cupola."*

4 . . Central Indiana . . Athenaeum Turners, Indianapolis. A. G. Herman, Ajax Specialties Co., *"New Developments in Pattern Equipment."*

4 . . Chicago . . Chicago Bar Assn., Chicago. J. R. Young, Cadillac Motor Car Div. GMC, *"Automated Sand System."*

4 . . Metropolitan . . Essex House, Newark, N. J. W. B. Bishop, Archer-Daniels-Midland Co., *"Where Do We Go From Here In Core Making?"*

4 . . Western Michigan . . Schuler Hotel, Grand Haven, Mich. H. F. Scobie, Non-Ferrous Founders' Society, *"What's New in the Foundry."*

4 . . Utah . . Skyliner Cafe, Provo, Utah. *"Pattern Construction and Rigging."*

5 . . Rochester . . Seneca Hotel, Rochester, N. Y. R. Olson, Southern Precision Pattern Works, Inc., *"Jobbing With Shell Molds and Cores."*

6 . . Toledo . . Heather Downs Coun-

Continued on page 91

M. HOLTZMAN METAL CO.

SMELTERS AND REFINERS
SINCE 1900

HOLMCO

GUARANTEED Brass, Bronze and ALUMINUM INGOT to your specifications IMPROVED WITH FACTOR "X"!
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CIRCLE NO. 128, PAGE 7-8

Inducto "Push-Out" Furnaces save minutes on every melt

Inducto "Push-Out" furnaces with removable crucibles save valuable minutes in transfer time on every melt . . . meaning extra melts per day . . . thousands of extra castings each year. The moment the charge in one crucible is ready for pouring, the power is immediately transferred to the waiting charge in the other crucible. The crucible of molten metal is raised from the furnace hydraulically so it can easily be transported to the molds.

Inducto "Push-Out" furnaces are short and compact, occupying minimum floor space. The operator's controls are mounted on the furnaces for convenience and accessibility. When teamed with Inducto Precision Control, these furnaces offer the ultimate in production melting.

More detailed information may be obtained by writing for Bulletin 70. Write today.

INDUCTOTHERM CORP.
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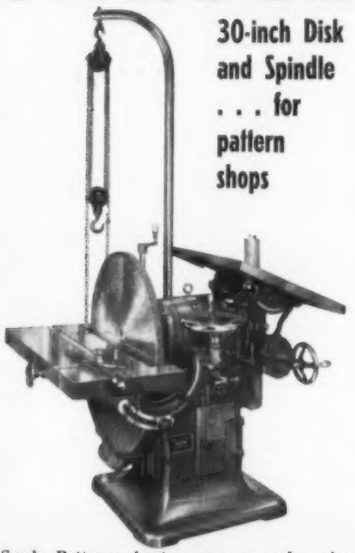
CIRCLE NO. 129, PAGE 7-8

OLIVER SANDER

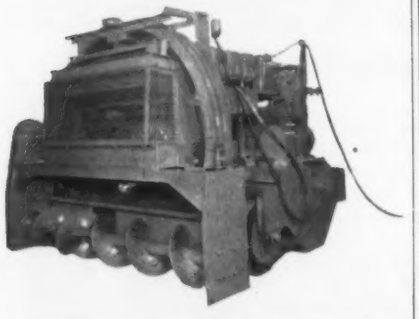
30-inch Disk and Spindle . . . for pattern shops



Sands Patterns—knots, cross or end grains, screws, nails, etc. Both tables tilt 45°. Disk table adjustable vertically. Takes spindles 2", 3", 4" diameter, 9" long. Duplicating and circle sanding attachments. Also made as a double disk and double spindle sander. Write for Bulletin No. 34.

OLIVER MACHINERY COMPANY
Since 1890 Grand Rapids 4, Mich.
CIRCLE NO. 136, PAGE 7-8

RINGLIFT SAND CONDITIONER



Ringlift foundry sand conditioners mix, add water, remove all sand from floor, screen, magnetically separate, aerate and discharge molding sand at rates to one ton per minute. Full width, screen-fed, permanent magnetic drum assures practically perfect shot iron removal.

Cuts swath to 104" wide, straddles windrows 24" high x 70" wide, but can handle much larger windrows or piles where it is unnecessary to straddle them. Turns in 63" radius, needs only 76" headroom. Most economical machine of this type to buy, to operate, to maintain.

For complete description & specifications write to

STATES ENGINEERING
CORPORATION
922 W. Berry St. Ft. Wayne, Indiana
CIRCLE NO. 137, PAGE 7-8

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For Sale, Help Wanted, Personals, Engineering Service, etc., set solid . . 25c per word, 30 words ($7.50) minimum, prepaid.

Positions Wanted . . 10c per word, 30 words ($3.00) minimum, prepaid. Box number, care of **Modern Castings,** counts as 10 additional words.

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Help Wanted

FOUNDRY METALLURGIST

An experienced foundry metallurgist is needed for a challenging and creative research assignment. This is an exceptional opportunity for a man with real ability to advance in our rapidly expanding Metals Research Department. Attractive salary and liberal benefits include tuition free graduate study and generous relocation allowance. Please send complete resume to:

J. A. Metzger

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of Illinois Institute of Technology

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METALLURGIST. Well established Midwest malleable iron foundry seeks experienced metallurgist. Excellent opportunity. Submit resume of education, experience and state salary requirements. **Box D19, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

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LARGE MODERN NORTHERN CALIFORNIA JOBBING FOUNDRY HAS OPENING FOR EXPERIENCED MELTING SUPERINTENDENT. MUST HAVE EXPERIENCE IN EITHER ELECTRIC STEEL MELTING, ELECTRIC IRON AND MALLEABLE MELTING OR BOTH. SHOULD HAVE EITHER COLLEGE TRAINING WITH FIVE YEARS EXPERIENCE OR HIGH SCHOOL EDUCATION WITH EQUIVALENT EXPERIENCE. WILL SUPERVISE FIVE MELTING FOREMEN. EXCELLENT OPPORTUNITY WITH GOOD FUTURE. SALARY OPEN. SEND WORK EXPERIENCE RESUME TO **BOX D20, MODERN CASTINGS, GOLF AND WOLF ROADS, DES PLAINES, ILL.**

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SALES SERVICE ENGINEER wanted by progressive producer of foundry supplies. This is a real opportunity for young foundry engineer with experience in sand and/or melting practices. College education is desirable. Ability to learn and develop is essential. Send complete record. Address: **Box D26, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

SALESMAN, experienced, to handle foundry supplies and steel mill supplies in the Chicago area. Send complete resume to **Box D27, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

Positions Wanted

MANAGER-SUPERINTENDENT. Practical gray iron foundryman technically trained graduate metallurgist with broad background of experience in jobbing machine tool paper machinery and high production. Well versed in metal, sand control, molding, gating, risering, cores, etc. Very low scrap record also low production costs. Desires connection with reliable firm demanding results. **Box D21, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

QUALITY CONTROL DIRECTOR. Metallurgist, master's degree, aged forty. Experience in ferrous melting, sand control, laboratory supervision, trouble shooting, research and development and process engineering. Desires full technical responsibility with progressive gray iron or malleable foundry. **Box D24, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

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Specialty Gray Irons
We have open capacity and solicit your inquiries for gray iron castings, ranging in weight from 500 pounds to 15,000 pounds. Quality castings produced under close metallurgical control. **Parkersburg Rig and Reel Company, Pomeroy, Ohio.**

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1—**SAN-BLO** Pulsator Model 40P-1 incl. std. equipment, 110 volt, 60 cycle, 1 phase motor. This core blower is practically new.
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1—750 lbs. Herman Hi-Speed Jarr Rollover 20" x 36" incl. Flask clamps and rear discharge roller conveyor in good working order.
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1—U.S. Model 64 double end grinder 20" dia. x 2" vitrified wheels—adjustable speed, 7½ hp. motor, 25 cycles.
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10 used Heat Treating Furnaces, and two 7-ton gantry cranes, good condition, priced to sell.

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FOR SALE—Well equipped and established non-ferrous jobbing foundry. Plenty of room for expansion. Located in Central Texas. Apply, **Box D25, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

SHELL MOLDING MACHINE. Late model Shell Process automatic molding machine—pattern size 20" x 30", gas fired, 220-60-3, excellent condition, operating now. **J. T. Moore, Wells Manufacturing Company, Skokie, Illinois.**

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A special Bonus Section in March **Modern Castings** will be entirely devoted to plastic patterns. And the story is written from a background of real working knowledge!

Don't miss it—the Bonus Section in your March issue of **Modern Castings.**

afs chapter meetings

Continued from page 89

try Club, Toledo, Ohio. W. R. Weaver, Modern Pattern & Plastics, Inc., *"Use of Plastics in the Pattern Shop."*

7 . . Canton District . . Mergus Restaurant, Canton, Ohio. H. Kessler, Sorbo-Mat Process Engineers, *"Cupola."*

7 . . Saginaw Valley . . Fischer's Hotel, Frankenmuth, Mich. *Student Activities Night.*

8 . . Chesapeake, Southern Section . . Greensboro, N. C. *"Injecting and Upgrading Iron."*

8 . . Corn Belt . . Fireside Restaurant, Omaha, Nebraska. Michael Bock, Exomet, Inc., *"Aluminum."*

8 . . Eastern Canada . . Sheraton-Mount Royal Hotel, Montreal. *Stump the Experts Night. (Prizes.)*

8 . . Mid-South . . Hotel Claridge, Memphis, Tenn. C. V. Nass, Beardsley & Piper Div. Pettibone Mulliken Corp., *"Mechanization in the Foundry."*

8 . . Philadelphia . . Dobbins Vocational School, Philadelphia. Prof. W. H. Ruten, Polytechnic Institute of Brooklyn, *"The Foundry Is A Good Place To Work."*

8 . . Wisconsin . . Hotel Schroeder, Milwaukee. *Management Night.* Dean C. E. Manion.

9 . . Northeastern Ohio . . Tudor Arms Hotel, Cleveland. *Ladies' Night.*

11 . . Central Ohio and Cincinnati District . . Suttmiller's Restaurant, Dayton, Ohio. Joint meeting. F. G. Steinebach, Penton Publishing Co., *"Can We Sell More Castings."*

11 . . Michiana . . Club Normandy, Mishawaka, Ind. Dr. R. A. Flinn, University of Michigan, *"Relation of Casting Structure to Service Performance."*

11 . . Timberline . . Oxford Hotel, Denver, Colo.

12 . . No. Ill.-So. Wis. . . Beloit Country Club, Beloit, Wis. T. E. Barlow, Eastern Clay Products Dept., International Minerals & Chemicals Corp., *"High Pressure Molding."*

12 . . Twin City . . The Covered Wagon, Minneapolis. J. Hetland, University of Minnesota, *"Legal Aspects Pertaining to Business Enterprises."*

14 . . St. Louis . . York Hotel, St. Louis. R. H. Jacoby, St. Louis Coke and Foundry Supply Co., *"Casting Quality."* Pattern Apprentice Night.

15 . . Birmingham District . . Anniston, Ala. W. A. Hambley, Charles A. Krause Milling Co., *"Scrap—Whose Responsibility?"*

15 . . Texas . . Hilton Hotel, Fort Worth, Tex. A. St. Clair, Fanner Mfg. Co., *"Chaplets."*

15-16 . . Southern California . . No regular meeting. California Regional Foundry Conference, Claremont Hotel, Berkeley, Calif.

18 . . Quad City . . Hotel Ft. Armstrong, Rock Island, Ill. C. L. Schwyhart, Caterpillar Tractor Co., *"Supervisor Development."* Management Night.

19 . . Eastern New York . . Panetta's Restaurant, Menands, N. Y. Prof. H. F. Taylor, Massachusetts Institute of Technology, *"Food for Thought."*

20 . . Central Michigan . . Hart Hotel, Battle Creek, Mich. W. R. Jaeschke, Whiting Corp., *"Good Cupola Practice."*

20 . . Portland . . Heathman Hotel, Portland, Ore. *Apprentice Contest.*

22 . . Ontario . . Royal York Hotel, Toronto. A. D. Barczak, Superior Foundry, Inc., *"Pneumatic Sand Reclamation."*

22 . . Tennessee . . Patten Hotel, Chattanooga, Tenn. H. W. Northrup, International Nickel Co., *"Ductile Iron."*

29 . . Chesapeake . . Engineers Club, Baltimore, Md. V. M. Rowell, Harry W. Dietert Co., *"Sand Testing and Good Sand Control for Making Better Cores."*

Now Where Was That?

■ You will have no trouble locating articles in back issues if you write for the free index to 1955 issues of MODERN CASTINGS.

questions and answers

MODERN CASTINGS invites its readers to submit questions concerning technical foundry problems. We can't guarantee to answer everything but we would like to try. This month we have been asked:

all purpose sand

Is there an all-purpose sand mixture suitable for heavy and light ferrous and non-ferrous casting?

It must be realized that the best casting results are obtained by tailoring the sand mixture to the metal and size of casting being made. However if necessity requires that only one sand mixture serve a variety of needs, the following mixture has been found quite versatile: 96 per cent washed and dried silica sand (135 gfn), 2 per cent western bentonite, 1.5 per cent dextrine, 0.5 per cent corn flour, and 5-6 per cent moisture. This mixture has a green strength of 6 psi, dry strength of 180-230 psi, green permeability of 38-48 AFS units, dry permeability of 52-65 AFS units, and hardness of 70-78 AFS units.

avoid a hard skin

How can we avoid machining difficulties arising from a hard skin on gray iron castings?

It is quite possible that the silicon content of the iron is too low for its total carbon content causing the rapidly cooled surface and corners to solidify as white iron. A small increase in silicon content or a late addition of an inoculating alloy to encourage graphitization should eliminate this difficulty. To machine castings with this hard skin it is recommended that the machinist take a deeper first cut so that the cutting edge of the tool will go below the chilled skin or edge into the soft gray iron.

why preheat?

What are the advantages of preheating a cupola air blast?

Preheating the cupola air blast improves the efficiency of combustion so that the ratio of metal to coke required to melt it can be raised from about 7:1 to as high as 11:1. Higher metal temperature at the spout, reduction in oxidation of alloying elements, faster melting rate, better use of low quality coke, reduction in slag problems and more uniform operation are a few other advantages of hot over cold blast.

melting turnings

What is the best way to melt aluminum scrap turnings and sheet?

Since turnings and sheet metal have a very large surface area exposed per pound of material the big problem is getting it melted without severe loss due to oxidation. Aluminum is especially susceptible to oxidation and the rate increases as the temperature rises. This oxidation loss can be held to a minimum by first melting a pig, ingot or heavy piece of scrap so as to form a pool of molten aluminum in the crucible. The small pieces of scrap aluminum are then immersed completely in the molten bath where they melt quickly without any appreciable melting loss. The use of protective fluxes, melting under a reducing atmosphere, and briquetting of scrap are other alternatives to consider for melting with a minimum of oxidation.

seasoned iron

Does seasoning or aging of gray iron relieve internal stresses?

Seasoning or aging of cast iron, usually outside, to relieve internal stresses, is an old practice which is rapidly being abandoned in favor of heat treatment. Investigations have shown that the combination of surface oxidation and fluctuating outdoor temperatures will effect, at the most, only a 15 per cent reduction of internal stresses in a period of a year or more. Most foundries cannot afford to tie-up their castings this long. They also require essentially 100 per cent stress relief to insure dimensional stability and maximum strength. Complete stress relief of gray iron castings may be attained by heating slowly and uniformly to 1100-1200 F, held at this temperature for one to two hours per inch of casting thickness, and then furnace cooled to at least 300 F.

WEDRON

A COMPLETE LINE OF 24 DIFFERENT PROCESSED SILICA SANDS

A CONTROLLED GRADE FOR EVERY CASTING NEED!

SAND SPECIFICATIONS — REPRESENTATIVE SCREEN ANALYSES

Unground Sand	4098	4085	4060	4040	4030	4020	5040	5030	5025
Ret on 20 Mesh	2.2								
Thru 20 ret on 30	38.6	12.4	5.6	0.6	0.4	0.4			
Thru 30 ret on 40	57.6	70.8	56.2	37.2	30.2	21.2	4.0	1.2	0.6
Thru 40 ret on 50	1.4	16.3	34.8	52.0	55.8	51.4	34.8	30.4	23.8
Thru 50 ret on 70	0.2	0.5	2.8	9.0	11.4	20.6	44.4	48.2	42.0
Thru 70 ret on 100			0.6	1.0	1.8	5.2	14.4	17.8	26.4
Thru 100 ret on 140				0.2	0.4	1.0	2.0	2.0	6.2
Thru 140 ret on 200						0.2	0.4	0.4	0.8
Thru 200 ret on 270									0.2
Grain Fineness (AFS)	25.88	30.49	33.72	37.48	38.82	42.22	49.96	51.64	56.90

Unground Sand	5015	5010	5005	7030	7020	7010	C-30	C-10
Ret on 20 Mesh								
Thru 20 ret on 30								
Thru 30 ret on 40	1.2	0.4	0.2	0.2	0.2			
Thru 40 ret on 50	15.2	11.2	4.4	3.0	2.4	0.4		
Thru 50 ret on 70	40.2	35.2	31.2	26.2	18.0	8.2	0.4	0.2
Thru 70 ret on 100	35.4	37.4	41.2	42.0	45.0	46.6	28.4	8.4
Thru 100 ret on 140	6.4	10.8	15.4	16.4	20.0	23.2	44.8	50.2
Thru 140 ret on 200	1.2	4.0	5.6	9.6	11.0	15.4	18.8	28.2
Thru 200 ret on 270	0.4	0.8	1.4	1.8	2.4	4.2	5.0	8.8
Thru 270 ret on 325		0.2	0.6	0.8	1.0	2.0	2.6	4.2
Grain Fineness (AFS)	60.20	66.92	73.92	79.36	84.42	95.44	108.22	124.60

Ground Sand (Flour)	80M	100M	140M	200M	300M	325M	400M
Ret on 60 Mesh	10/20%						
Thru 60 ret on 100	25/30%	5%					
Thru 100 ret on 140	15/20%	14%	4%	1%			
Thru 140 ret on 200	10/15%	16%	6%	4%	2%	Trace	
Thru 200 mesh	25/40%						
Thru 200 ret on 270		10%	12%	6%	2%	0.5%	Trace
Thru 270 ret on 325		12%	8%	9%	11%	4.5%	2%
Thru 325 mesh		43%	70%	80%	85%	95.0%	98%

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MAGNESIUM ALLOYS	for all types of castings
MAGNESIUM ANODES	for cathodic protection
ZINC ALLOYS	for die castings and metal forming dies

* Furnished in ingot, shot, piglet, grained and special forms.
** Furnished in ingot and shot.

Technical Services

Spectrographic standards
Metallographic and X-Ray Examinations
Chemical Analytical methods
Physical and mechanical property tests
Chemical, spectrographic and quantometer analyses
Field Engineering

Research leadership back of every ingot

A practical, working knowledge of your problems . . . a superior product to meet them. These are the standards by which Apex Ingot is made . . . the reason why Foundrymen and Die Casters everywhere say, "It's best in every test from Ingot to Casting!"

APEX SMELTING COMPANY

CHICAGO CLEVELAND LOS ANGELES

modern castings

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